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Western Electrician.

EVERY SATURDAY.

VOLUME II.

NUMBERS 1-26.

January 7—June 30, 1888.

ELECTRICIAN PUBLISHING COMPANY,

CHICAGO.

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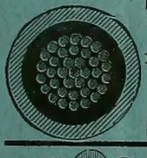

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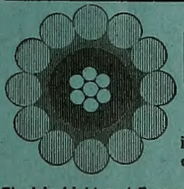

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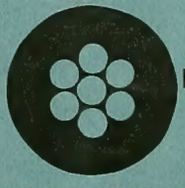

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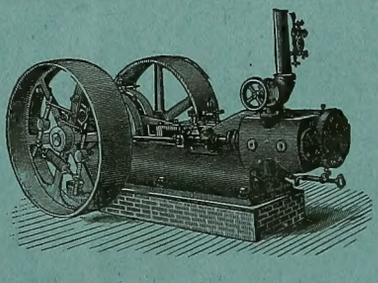

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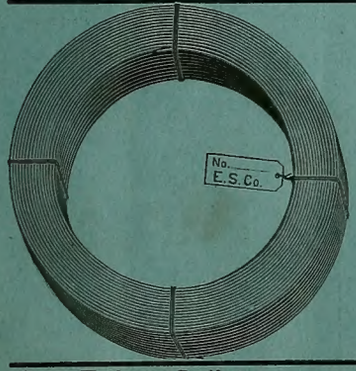

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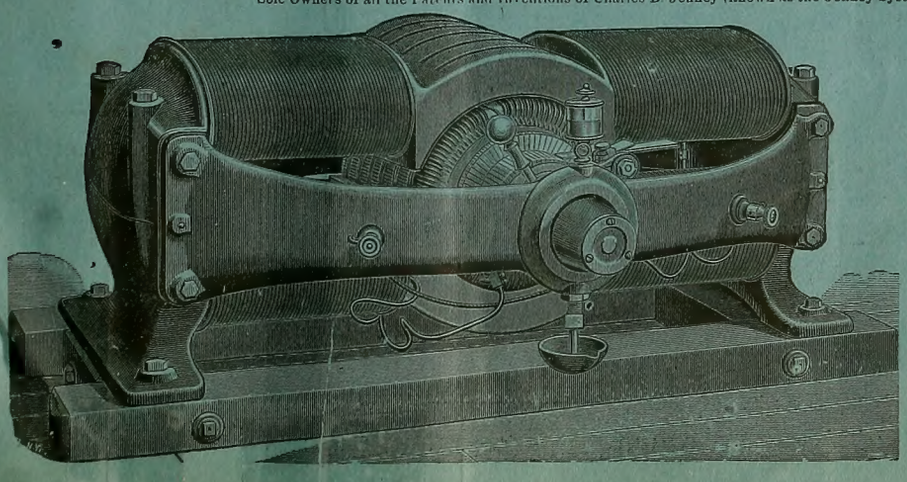

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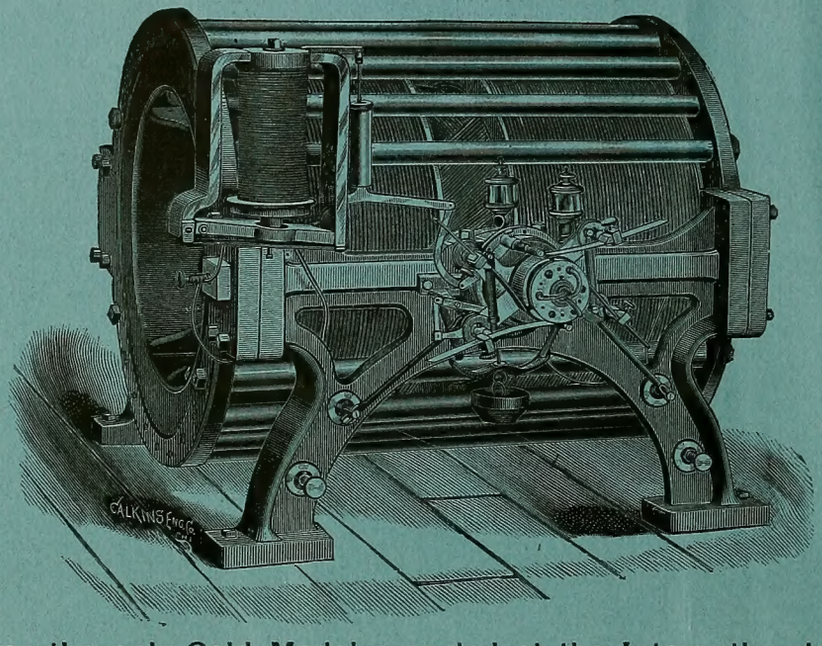

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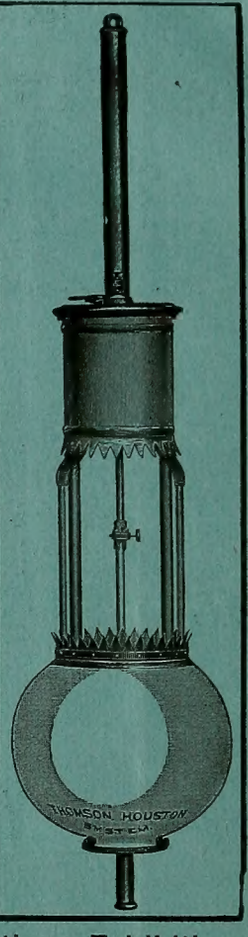

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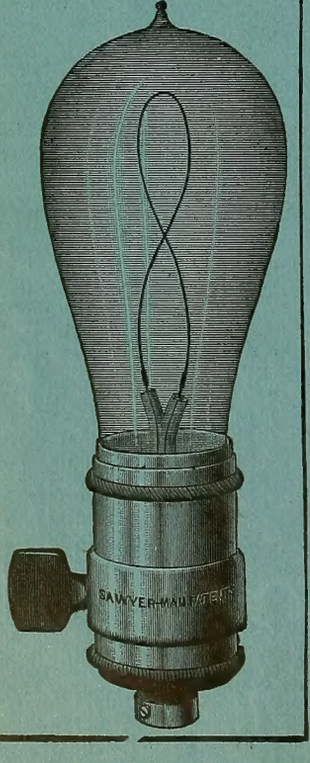

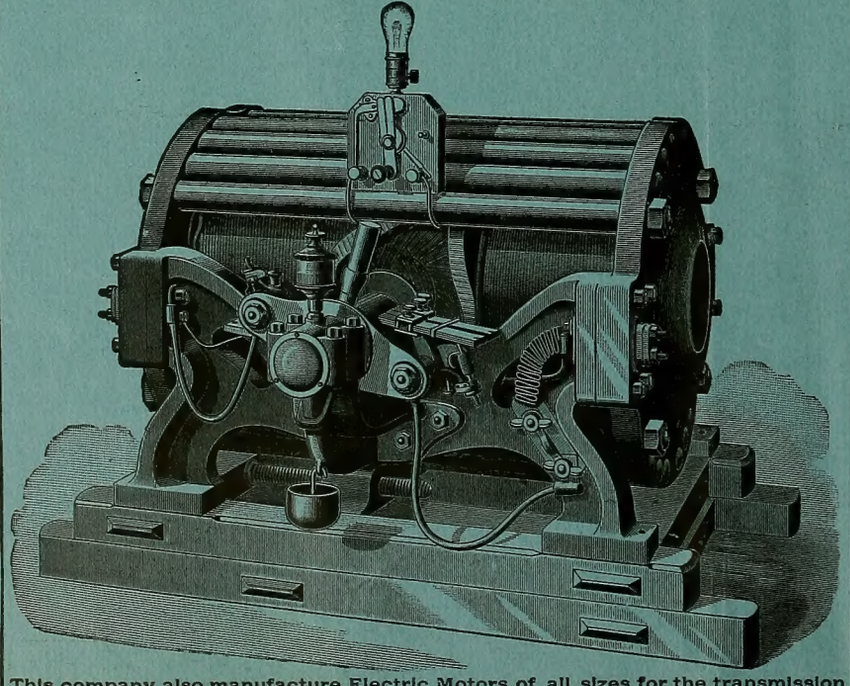

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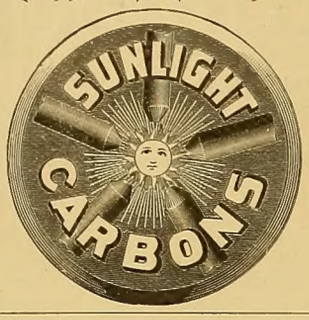

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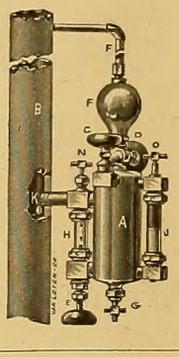

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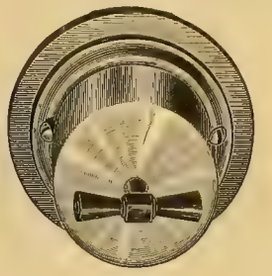

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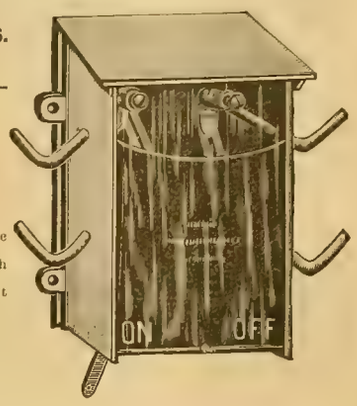

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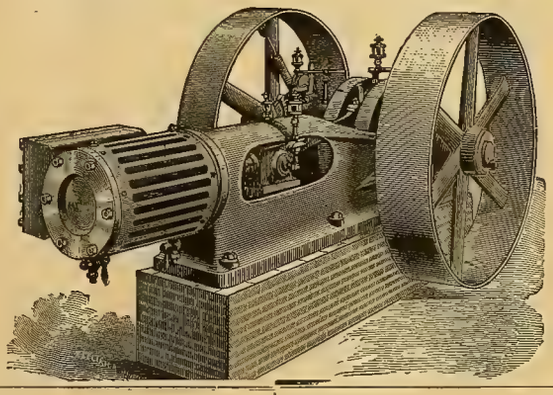

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Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, JANUARY 7, 1888. No. 1.

Automatic Telegraphy.

The accompanying cut is an illustration of a receiving perforator and transmitter for automatic telegraphy, invented and patented by Chancy G Wright, of Chicago. The object of the machine is to receive and transmit, or relay a message any number of times without the aid of an operator other than the original sender. In other words, by this device, a message can be sent from New York to San Francisco, and relayed as many times as desired, without human aid except that necessary to keep the instruments in adjustment. The receiver works on the local circuit, and can be used on the quadruplex as well as a single wire, or wherever a sounder can be used.

By this machine the dots and dashes are received on tape perforated, thus forming an indelible and perfect record of what has been sent. To relay the message thus received, it is only necessary to pass the tape through the transmitter. This operation does not injure the tape in any way, and it can be used any number of times, while five years afterwards it can be taken from the files and reproduced exactly as originally sent.

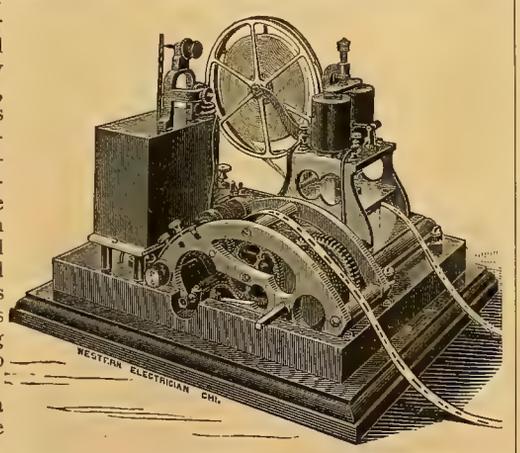
The machines are simple in construction, containing no parts likely to get out of order, and the automatic receiver requires no more adjustment than an ordinary sounder. The manner of perforating the tape is at once simple and effective. There is a small punch actuated by an electro-magnet and circuit-breaking device, which is kept in operation when the circuit is closed. As the tape is kept in motion by clockwork, the punch, which moves with great rapidity, cuts a dash in the tape. Hence, the opening and closing of the circuit, as the Morse characters are made, exactly reproduces them in perforated dots and dashes on the tape. All danger of tearing or checking the tape that would result from pulling the paper when the punch is in operation, as is common in machines of this character, is obviated by a devise for pushing the paper tape through guides so made as to admit of a slight buckling of the tape.

The transmitter is equally simple. There is a perpendicular rod, having a small foot at the lower end, and pivoted at the bottom. On the end of the foot is a small wheel under which the perforated tape is passed by means of clockwork. The contact is not made through the perforations, but at the top of the rod, the closing and breaking of the circuit being effected as the wheel drops into the perforations or runs upon the tape; that is, whenever the wheel drops into the perforations the circuit is closed. The point of contact being removed from the tape, all danger of interruption from fibres of the paper is obviated.

The object of the machines is to save labor, and their advantages in this direction must be patent to practical telegraphers. For instance, take the transmission of press reports. This matter, say, is sent from New York to Chicago and other large cities, where it is distributed throughout various circuits. By Mr. Wright's machines the report could be received at these distributing points on the perforated tape, without the aid of receiving operators. Then the tape could be passed through transmitters and the report sent out on any number of circuits, without the aid of sending operators, one man being able easily to keep a number of instruments in adjustment.

In New York the telegraph companies have a large number of branch offices. It is the custom for all business taken at these offices to be sent to the main office, where the messages are re-sent over the trunk lines, thus requiring the services on each message at the main New York office, of both receiving and sending operators. If this business were received by means of the automatic perforators, the automatic transmitters could be used to send the messages on the trunk lines, and thus the services of both receiving and sending operator could be dispensed with.

The amount of labor that may be saved by this use of these machines is obviously enormous; but they may also be used to great advantage in other ways. It is a fact well known to telegraphers, that in bad weather long circuits are worked with the greatest difficulty, while short circuits can be worked successfully in almost any kind of weather. This difficulty is often found to be a serious one in working the lines between New York and Chicago, and still more so in the lines to the Pacific coast, where the circuits are long and bad weather is almost certain to be encountered somewhere along the line. By means of automatic receivers and transmitters these long circuits could be split up into a series of short circuits by placing machines at convenient intervals along the lines, thus forming a perfectly working line for any distance in any



kind of weather, and this, too, without the aid of additional operators.

Mr. Wright's machines recently were given a test in the presence of several well known telegraph men, and were found to do their work perfectly. The receiver recorded the work of operators noted for rapid sending, and did the work as well at fifty words a minute as at thirty. There is practically no limit to the capacity of the transmitters.

Opening of the Haymarket Theater.

As mentioned in the last number, the Haymarket theater, Chicago, was opened Saturday, December 24th. This beautiful theater was christened after the famous old Haymarket theater, in London, and not, as inferred by many, after the Chicago Haymarket. The theater was built by architects Flanders & Zimmerman, and decorated by Mr. Albert. It is the largest theater in Chicago, having a seating capacity of 2,800. Will. G. Davis, manager of the old Haverley theater, or as it is now called, the Columbia, has leased the Haymarket. and proposes to make it first class in every respect.

The theater is beautifully lighted by United States incandescent electric lamps. The plant was contracted for by C. C. Warren, western manager of the United States Electric Lighting company. and put in under the personal supervision of F. B Badt, the company's superintendent of construction. The plant consists of two 600 and one 200 light United States Incandescent dynamos, rnn by two Ide engines, one $14'' \times 20,''$ and the other $8'' \times 12''$.

The theater, including stage, auditorium, dressing rooms, foyer, etc., is lighted by 1,300 incandescent lamps. The artistic arrangement of the lamps reminds one of the tales of "Arabian Nights." The plant started in excellent shape, and has been running since without the slightest hitch or flaw. The stockholders, represented mainly by Messrs. Griffin and Dwight, are very much pleased, as is everybody connected with the theater.

The latest ideas and improvements in incandescent wiring have been carried out in this plant; nothing but kerite wire of the highest insulation has been used. All safety devices are accessible at any time, without interfering in any way whatever with the performance or the audience.

The most novel feature is the arrangement of the switch board and controlling devices in the first stage entrance. Every light on the stage and in the auditorium is controlled by handles which may be used singly or in unison, as desired, by means of the most simple apparatus yet devised for the purpose. This whole arrangement of controlling devices and their construction was gotten up for the place by Mr. Badt. Mr. Davis, the manager, who has seen every theater in the the United States that is lighted by electricity, declares that he never saw anything more simple or more perfect in this line, and thinks his plant perfection. Thomas Keene, who opened this theater with "Richard III," and played a week's engagement, joins Mr. Davis in the statement.

This plant also lights the large office building connected with the theater, and the whole plant when finished, will comprise dynamo capacity for about 2,000 lamps, with about 2,600 lamps in position. The United States Electric Lighting company is to be congratulated on carrying to a successful completion a contract which redounds as much to its credit in every way as this.

Lighting the River.

The first step towards carrying out Prof. Barrett's idea of lighting the river by electricity, has been taken, in the installation of the initial plant of the Western Electric company's system. It is expected, and certainly to be hoped, that the work will be continued, and carried out in full according to Prof. Barrett's plan.

Chicago Electric Club.

This evening the Chicago Electric Club gives an entertainment and lunch on the occasion of the dedication of its new rooms at 122 and 124 Clark street. Eight o'clock is the gathering time and a pleasant evening's entertainment is promised by the gentlemen of the entertainment committee. There is certain to be a very large turnout and a thoroughly enjoyable evening is before those who attend. The tickets have been placed at a very low price and can be obtained of the members of the entertainment committee or of the treasurer or secretary. In addition to the lunch an interesting musical programme has been provided by the entertainment committee, under whose direction the whole affair has been planned and will be carried out. The entertainment is to be entirely informal.

The Adams Elevated Railway.

The agitation for rapid transit on the west side in Chicago has brought forward the advocates of different modes of transit, surface, underground and aerial. As has been pointed out heretofore, surface roads affording rapid transit are quite out of the question on busy thoroughfares, while the cost of building an underground road is enormous. The elevated road seems to be the choice, and, as has been urged, the elevated road with electricity as the motive power would afford the easiest and best solution of the problem of rapid transit.

The system shown by the cuts in connection is known as the Adams single track, single column elevated railway and was designed by James W. Adams of Chicago. The cars can be operated by electricity and it is thought that a practical demonstration of the system will be had within a short time.

The railway is built of iron or steel; the girders that carry the track are longitudinal and rest on single columns which stand on solid foundations placed the required depth below the street level, to give the structure stability and rigidity against the effects of the dead and moving load, acting vertically and longitudinally, and also against the forces acting transversely, such as wind pressure, unequal loading, centrifugal force and lateral impacts due to the movement of the cars with a speed of twenty miles per hour. The railway is of single rail type. Two large swiveled paper wheels support the load and move on the rail with a flange in the center of the tread moving in a slot of the rail. These large supporting wheels are held in position and prevented climbing the rail by smaller pilot wheels. The rail is placed inside of and considerably above the floor level of the car, making it impossible for the car to fall to the street below, even if derailed. Below the car and attached to it are four horizontal guide wheels, two on each side, moving along against a vertical face, to insure steady motion while running, and resist the transverse forces due to wind and unequal loading.

The cars are arranged with longitudinal seats facing outward, with sufficient room between them and the sides of the car for the passengers to get in and out conveniently. There is to be no terminus, but the cars are to move on a loop, thus making it possible to have a continuous movement of cars.

Fig. 1 represents an end elevation of the system. Fig. 2 is side elevation. Fig. 3 is an elevation of one of the cars, together with the opposing stations. Fig. 4 is a side elevation of one of the stations, and the approaches. Fig. 5 is a bottom plan view of a car turning a curve, which also indicates position of seats and guide wheels. Fig 6 is an end view of car, showing arrangement of platform for crossing track. Fig. 7 is a top plan view of same. Fig. 8 shows in section the operator's platform in front, and also adjoining platforms for smokers. Fig. 9 is a plan view of the same. Fig. 10 is a bottom plan view of the tracks for the guide wheels of the car. Fig. 11 is a central longitudinal section exposing the supporting wheels with their pilots, and also the location of guide wheels. Fig. 12 is a central transverse section of one of the cars, upon the track, showing location of wheels relative to the track, and also position of the guide wheels.

The steering wheel is an important feature of this invention: it gives direction to and also steadies the car wheel in its forward travel, like the guide wheel of a bicycle; and this is true whether a car wheel is running in a straight line or in a curve, for it turns with the car wheel because of the attachment of both to the same turn table. The effect of this directing wheel is to extend the rail bearing of the car wheel, and to destroy the natural tendency of the same to a lateral vibration or movement during its forward travel; for, being of a smaller diameter, and considerably outside of a line to the axis of the turn table, the directing wheel responds more quickly to laterally acting forces, and by a steering action forcibly maintains and directs the car wheel in a line with the rail—whether the rail be on a curve or on a straight line.

Some of the other peculiarities claimed for this system are: that the structure on which the cars are to be run will be no wider than 14 inches; the tracks are to be arched at street intersections; there will be no cross structure of any description; derailment of cars, by the very principle of the system, will be practically impossible; switching and cross tracks are provided for; entrance and exit are from the rear platform only; and there are to be no conductors—only station agents.

Cars are to run continuously, according to this system, except when halting at stations to take in or let out passengers. There will be no "trains"—only single cars; starting at one side or end of a city the railway will reach the opposite side or end along one street, and then form a loop and return along a parallel street. Thus confusion will be impossible, and the crowd will be under the control of one person, at the station entrance. Cars need not stop, if full, except when passengers want to get out; and two independent cars may be handled simultaneously. The entrance to a station will be on one side, and the exit on the opposite side.

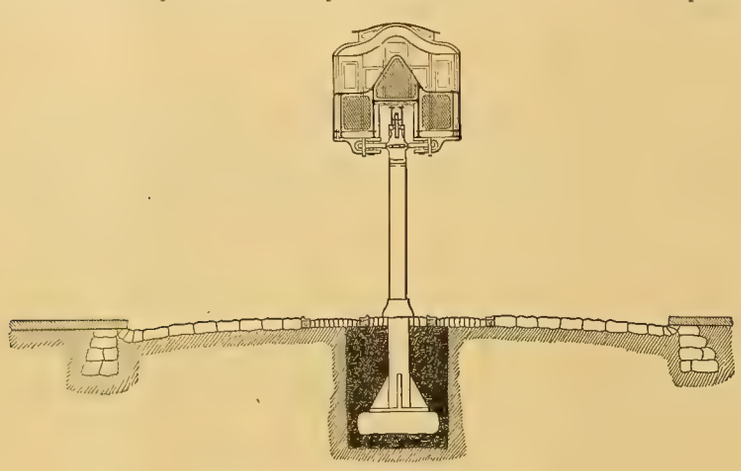


Fig. 1.—Adams' Elevated Railway.

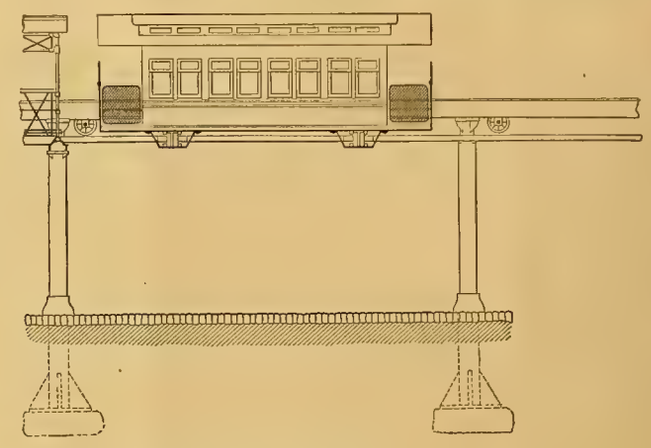


Fig. 2.—Adams' Elevated Railway.

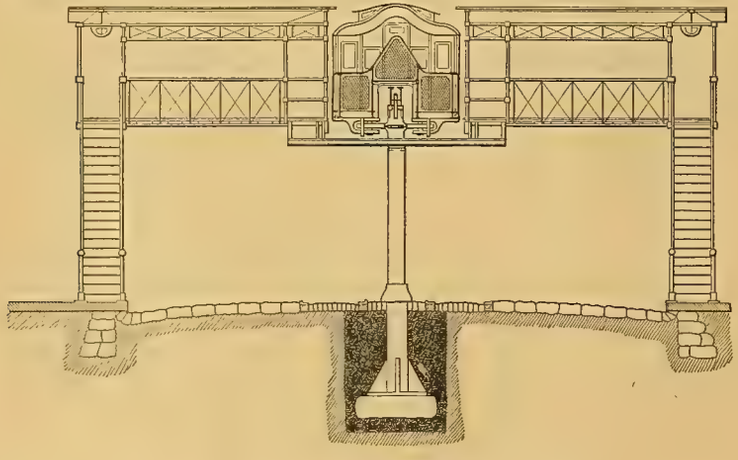


Fig. 3.—Adams' Elevated Railway.

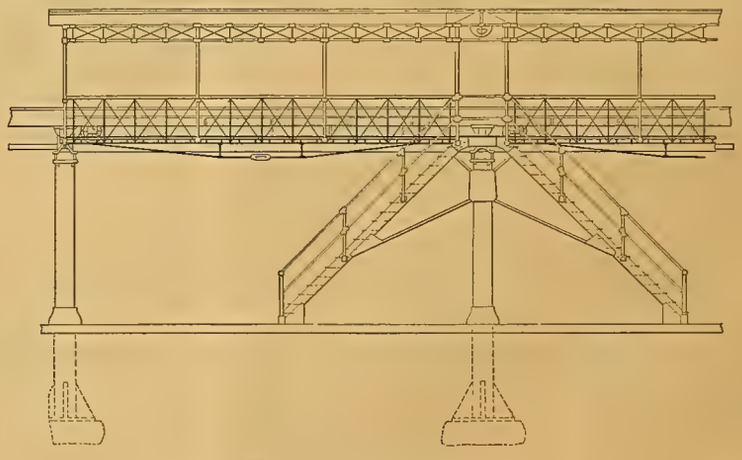


Fig. 4.—Adams' Elevated Railway.

Resume of Electric Progress, 1887.

By Dr. Robert Grimshaw.[1]

Telegraphing without wires is again the subject of experiment. Telegraphing between vessels at sea, using water as the transmitting medium, is being experimented with by Edison and others. Train telegraphy is occupying the attention of inventors, two or three systems having been successfully tried on an experimental scale. In one the tin roofs of the cars are utilized as one leaf of a condenser, charged and discharged by a buzzer many hundred times a second; the other leaf is represented by a line of wire on low poles carried along the track as nearly as possible at an even distance from the track. The connections are the acme of simplicity. Field telegraph trains are being arranged by the Portuguese and other European governments. One carriage constitutes the telegraph station, with convenient accommodation for despatching messages; next comes a van for 150 poles, a third to carry a supply of 11,000 yards of four-twisted wire, then a carriage with all the requisite tools, and the last two for various stores. By recent improvements in fast speed telegraphy 600 words per minute are attained at the London post office.

1 New York *Sunday World*, January 1, 1888.

ELECTRIC LIGHTING.

One electric light system for cars embodies both the dynamo and the storage battery, seeking to overcome the defects from one source of electricity by the use of its conjugate. Dynamo and engine are in the baggage-car and steam supplied from the locomotive, the storage battery taking up the work when the loco is uncoupled. The method of electric lighting of

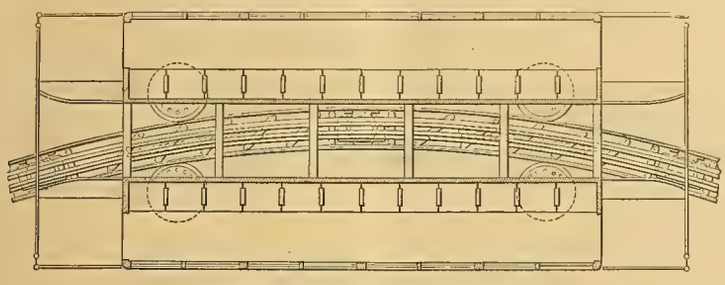
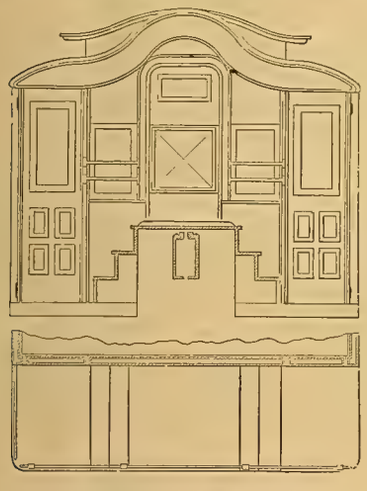


FIG. 5.—ADAMS' ELEVATED RAILWAY.

trains tried upon the Glasgow City and District railway, which has a large number of tunnels, lays from one end of each tunnel to the other a third rail of T-iron, on which contact-making wheels are automatically pressed, and which are in communication with the source of electricity and furnish electric light during the times in which the cars are passing through the tunnels, and at no other time. The electric headlight for ships has been the object of several experi-



FIGS. 6 & 7.—ADAMS' ELEVATED RAILWAY.

ments, but is as yet not a complete success. New Orleans has adopted Flad's system of overhead wires upon tall towers at the street corners. The Vienna Opera house is now successfully lighted by electric light. The alternating system seems to be gaining headway. One of the most healthful signs in the electric lighting business is the burying of the hatchet and the affiliation of interests by several companies hitherto most bitterly

FIG. 10.—ADAMS' ELEVATED RAILWAY.

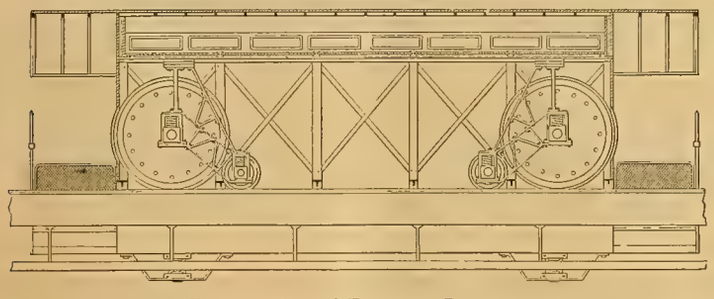


FIG. 11.—ADAMS' ELEVATED RAILWAY.

inimical. To this end those representing the Sawyer-Man interests appear to have been the most conducive.

THE TELEPHONE.

A method proposed for establishing telephonic communication between ships at sea, provides each vessel with an apparatus for producing sound under water and with a suitable receiver, the latter consisting of a short pipe passing through the keel, open at the lower end for the admission of water and closed above. Inside is a microphone receiver with wires connected to a telephone in any convenient place. A system of military telephony tried in Belgium requires no insulation up to one or two miles, speech being transmitted through a naked wire laid on the ground. The telephone has been used in New South Wales by the postal department for communicating between districts where telegraphic business is not sufficient to warrant employing an operator. Sylvanus Thompson has produced a magneto-telephone upon the dynamo principle. The telautograph of Gray, reproducing a message telegraphically by a tracing point, either in ink or pencil, should, in certain circumstances, be an admirable supplement to the telephone. Steno-telegraphy, a combination of mechanical stenography with telegraphy, requires at the transmitting section a key-board perforator and automatic transmitter and distributor, and at the receiving station a distributor, polarized relays equal in number to the keys of the key-board of the perforator and a printing apparatus. The perforations represent one syllable each. Experiments in France give with a single line wire for 210 miles, 400 words per minute; for 540 miles, 200 words.

ELECTRIC POWER.

Compressed paper friction driving gear for dynamos has been tried with considerable success.

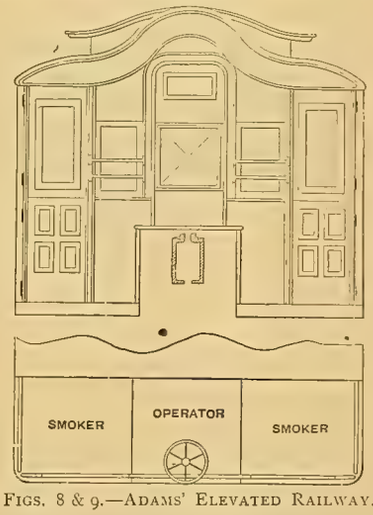
Electric motors have been successfully used in calico printing works. Rowan, of Glasgow, has devised self-attaching machine tools actuated by electricity, as for instance, riveting machines attached to the sides of iron-holds, by electro-magnets, thereby enabling closing up of the last rivets, without anything to strike against; and caulking, chipping, drilling, tapping, and other tools upon the same self-attaching principle. Using in both the holding on magnets and the motor, electrical energy of only three-quarter horse power, holes one inch in diameter have been drilled through one and one-half inches of solid wrought iron, and one and five-eighths inches of mild steel in two plates of thirteen-sixteenths inches each in one minute and forty-five seconds per hole. The Lay traveling torpedo, which is controlled by electric wires, has been tried during the year, but not with any great degree of success.

The Buffalo Electric Light company has made a contract with the Niagara Falls Hydraulic Tunnel and Power company to take 10,000 horse power at $15. per horse power per year for lighting the city and for manufacturing. A new electric launch, the Victoria, measures 90 feet in length by 11½ feet beam. She will not only carry accumulators, but have her own dynamo. Electrical hauling plants have been tried with a view to demonstrating the practicability of this method of friction to underground working, but so far without success. The Reckenzaun electric storage battery and motor are reported as working well on the roughest tracks in Philadelphia without hitch and practically noiselessly. Mr. Edison is stated to be thinking up an electric street-railway system that will not require any overhead wires or underground conduits. In the electric locomotives upon the North Metropolitan Tramway company's line from Stratford the gearing is entirely new. The dynamo is on top of a vertical shaft coupled to one of the car axles by bevel wheels. The difficulty of brush reversing has been avoided by placing two bevel-wheels on the axle, one on each side of the driving pinion.

GENERAL ELECTRICAL INVENTIONS.

To resist the subtle influences of magnetism and electricity which are now at work upon all hands, Paillard has devised a non-magnetic alloy of palladium. Springs made of this are absolutely uninfluencible by the most powerful magnetism, and are also non-rustable. Very dense graphitoidal carbon for incandescent electric lighting has been produced by passing an induction coil discharge through coal gas.

Sir William Thompson has produced for electric installations on shipboard a voltameter, consisting of a small oblate piece of soft iron sup-



FIGS. 8 & 9.—ADAMS' ELEVATED RAILWAY.

ported on a stretched platinoid wire in the center of a solenoid of fine copper wire connected in series with variable platinoid resistances. The oblate tends to turn its equatorial plane parallel to the lines of force in a uniform magnetic field. Pellat has devised an electro-dynamometer which gives current intensity in absolute value with an error under 1-200,000. There are two concen-

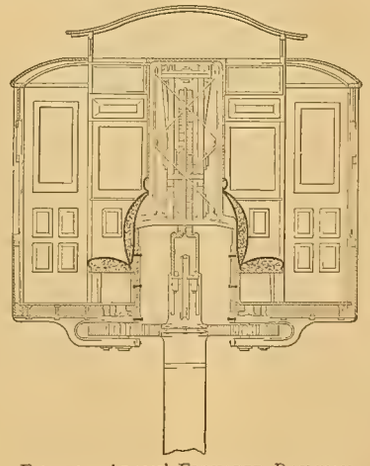


FIG. 12.—ADAMS' ELEVATED RAILWAY.

tric coils, the outer having its axis horizontal, the inner vertical. The same current is passed through both bodies, and the small one in the almost uniform magnetic field of the larger is turned by a couple tending to deflect its axis from the vertical. Edison has produced a magnetic bridge or balance for measuring magnetic conductivity, designed to do for magnetic meas-

urement what Christie's instrument, commonly known as Wheatstone's bridge, does in electrical science. Silk fibre suspension in galvonometers has been done away with in favor of wire. A new unit of time, proposed by Lippman to the French Academy of Sciences, as a substitute for the ordinary second, is an electrical resistance which can be shown to represent an interval of time—for instance, a tube of mercury.

NEW APPLICATIONS OF ELECTRICITY.

The flashing point of mineral oil is now determined by the induction spark. Magnetic train-signals have been brought out, in which the impact of the wheels passing over and depressing a lever at the side of the rails, causes a bobbin to vibrate in an electric field, thus generating a current. The incandescent electric lamp has been introduced in connection with the helmets of divers, and a telephone fixed to the inside of the helmet carries the diver's voice to his assistant, and vice versa. Bruce has furnished the Belgian Government with a captive signalling balloon, lighted inside by electric incandescent light, from which the current is cut off and let on by a key like that used in telegraphy. The past year was the first in which the Atlantic cable was used to transmit medical prescriptions and treatment for a patient. A novelty for the Chinese service is a combined cruiser and telegraph-cable ship. The subject of electrical connection with lightships has been very strongly impressed upon the public mind, and the Trinity Board has the matter seriously under consideration.

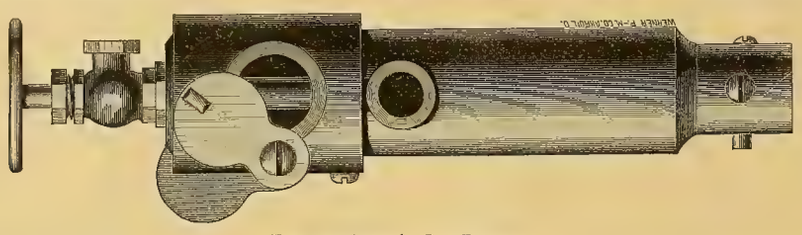


FIG. 2.—ASKIN'S OIL BURNER.

The distribution of electrical energy by inductive transformers has called forth many conflicting opinions, but the principle has received several practical applications during the past year. In one installation at Llewellyn Park, dynamos of 600 volts are used, giving 1,200 volts pressure between the positive and negative leads. From the sub-station lamps the motors, situated at 100 to 200 blocks circuits, will be supplied with a uniform current at constant potential.

Edison has propounded a method of procuring electricity by direct action of heat, substituting for mechanical motion in the armature molecular motion obtained by the direct action of heating and cooling agents. Experiments have been conducted concerning the practicability of dispersing smoke by electricity. An electric fire-damp indicator has been produced, the principle being that when a mixture of air and fire-damp has burned, the volume of the mixture is diminished in proportion to the amount of air-damp. Steel watch-springs are now tempered by passing through them an electric current while they are immersed in an oil bath. An electric signal trumpet, designed to warn or signal vessels, trains or tram-cars, can also be used as a Morse sounder. The electric welding of metals, discovered by Elihu Thompson, is one of the greatest recent novelties of the current year. The telemeter system, by which the slow movement of a revolving hand on any indicating instrument may be reproduced by the movement of a similar hand at a distant place, using electricity to convey the impulse, is finding numberless applications. In Berlin a company announces that in addition to light, it will be prepared to furnish electricity for heating purposes. This is accomplished by heating water by a resistance coil. In certain theatres electric stoves are employed for heating the curling-tongs.

Consumers' Electric Light Company.

The Consumers' Electric Light company of Chicago will do commercial lighting. They have a central station, at Blue Island avenue and Twelfth street, and have a capacity of 120 Van Depoele lights.

The Askin's Oil Burner.

The cost of fuel is an important question to every manufacturing establishment, and the line of devices which have for their ultimate object economy of the coal pile, is an extended one. This question is one that enters largely into the cost for maintenance of electric light stations wherever situated. Recently, there have been several installations of electric light plants where crude petroleum oil was used for fuel and a description of appliances used and statement of results attained will be of particular interest to those electric light companies who can avail themselves of crude oil for fuel under boilers.

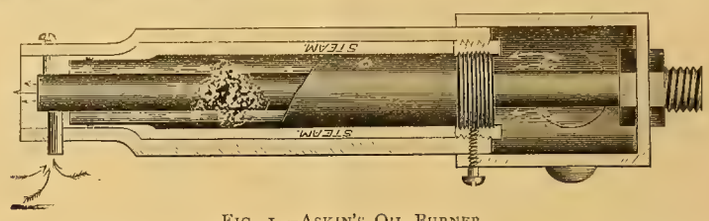


FIG. 1.—ASKIN'S OIL BURNER.

The illustrations in connection show the burner and method of use under a boiler of the Askin's Oil Burner Co. of Lima, O.

The burner in reality is a gas generator and can only be used where steam is obtainable. By the use of steam, air and oil passing through the burner independently of each other, and which are thoroughly mixed as they leave the burner, a hydro-carbon gas is formed, which burns similar to natural gas, but with more intense heat.

Fig. 1 shows a section of the burner and Fig. 2 a perspective view. As will be seen, the oil, air and steam pass through the burner by three separate channels. By this means all possibility of the burner ever becoming clogged is effectually prevented. The oil passes through the center 3-8 inch pipe and the air entering the air chamber through the openings for that purpose on either side passes through a 1-inch pipe surrounding the oil pipe. The steam passes out on the outside of the air pipe. As will be readily seen, the steam surrounding both the air and the oil as it leaves the burner, both air and steam are consumed.

By means of the angle valve on the rear of the burner, Fig. 2, the supply of oil is regulated for a fire of any desired size or heat. The openings over which the sliding doors close are for admitting air in any desired quantity. The opening in front of the air chamber is for admitting steam.

Fig. 3 shows the burner in operation under the boiler. The tank is for holding the day's or week's supply of oil. It feeds into the burner by gravitation. The steam supply pipe from the dome of the boiler is shown with a globe valve for the regulation of the amount of steam needed. The bridge wall under the boiler is shown in the cut close to the front. The intent is obvious. The blast of flame impinges upon the bridge wall first and is then turned upward along the length of the underside of the boiler, thus preventing a concentration of heat upon a single spot of the boiler shell.

The manufacturing company state that two barrels of oil will equal one ton of the best slack coal in generating steam, or in furnaces of any kind; and that three barrels will equal one ton of the best lump coal. As a steam generator it is superior in cheapness, cleanliness and convenience, since one man will take care of a battery of ten boilers more easily by this system than of one boiler where coal is used. It excels as a fuel where a steady and uniform power is desired, and is especially adapted for electric light plants, as the burner can be regulated to produce a fire of any degree, and changes only at the will of the operator.

The advantages of oil over coal as a fuel are claimed to be that it is cheaper; it makes no smoke; it takes no labor; is perfectly clean, no no ashes or cinders; it keep a uniform heat; it can be regulated to make a large or a small fire; it can be instantly extinguished; one man can do the labor of ten; perfect combustion; no grate bars to burn out; no lack of steam; steady and uniform power; fifty per cent. more power can be obtained from the same boilers than with coal.

Among the electric light plants using this system are: The Jenney Electric Light and Power Co., Fort Wayne, Ind.; Grand Rapids Electric Light Co., Grand Rapids, Mich.; Menominee Electric Light Co, Menominee, Mich.; Brush Co., Detroit, Mich.; Louisiana Electric Light and Power Co., New Orleans, La.

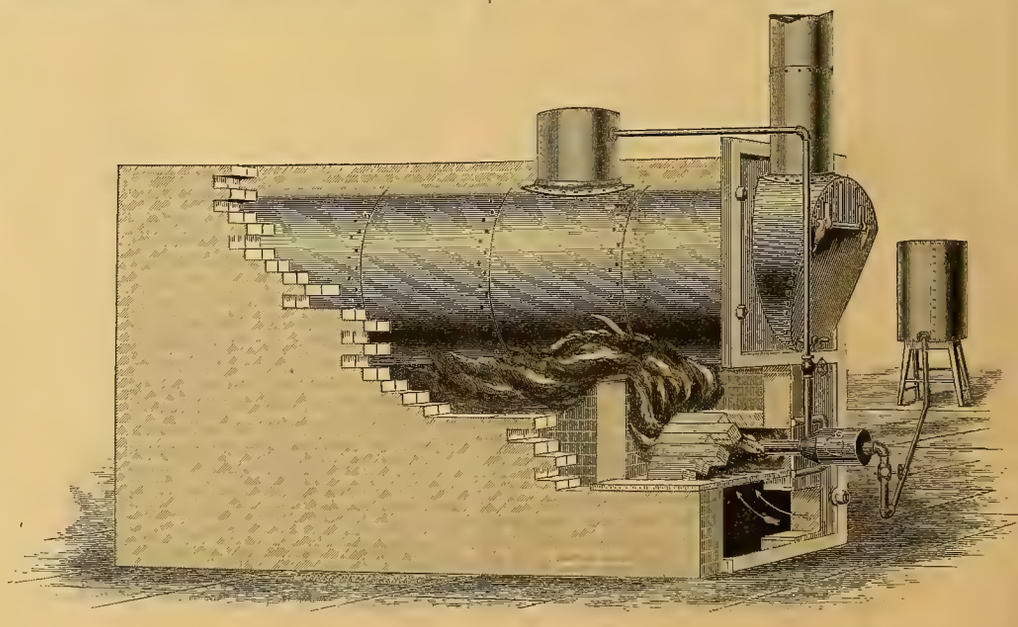


FIG. 3.—ASKIN'S OIL BURNER.

By the explosion of one of the boilers in the Edison central station at Westchester, Pa., recently, seven persons were killed or so badly injured that they subsequently died.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number XXIV.

The Cardew Voltmeter.—The various instruments thus far described can be used only with generators which have a constant current in one direction; they are also liable to errors arising from self-induction and other causes. Since, according to Joule's law, the heat developed in an electric conductor is in direct proportion to the strength of the electric current passing through it, it is evident that instruments can be constructed on this principle which will accurately measure either current strength, or difference of potential in generators producing either constant or alternating currents, and which shall not be liable to variation from any of the causes mentioned. Among these, the voltmeter of Captain Cardew, patented in 1886, has a prominent place. It depends, as will be seen, on the expansion of metal produced by the electric development of heat.

Fig. 59 gives a front view of the instrument and Fig. 61 a rear view, showing its internal construction. A fine platinum silver wire of about .0025 inch diameter, and 8 feet total length is stretched in four lengths in a horizontal tube, about two feet long and 2½ to 3 inches diameter. The tube is made of very thin metal, one third of its length being iron and two thirds brass, to maintain constancy of length between the points of attachment of the wires by such a mode of connection as shall produce compensation by the unequal expansion of the two metals; the same result is also attained by the use of brass and iron rods. The tube is placed horizontally to prevent inequality of temperature from convection of the air.

In Fig. 61 is shown a metal frame, *B B B B*, to which the working parts are attached, the wire *a a*, attached to the support t', extends into the tube to the left, passes over a pulley attached to an insulated support at the left end, returns to a central pulley *i*, is extended again into the tube, passes over a third pulley at the end, and returns to the support t^2, where it passes over another pulley, and is attached to an adjusting screw, the end being extended with a certain amount of slack used in adjusting, and connected with the lower binding-post; connection being also made between the upper binding post and support t'. The pulleys are made of ivory for insulation and have jewelled bearings to reduce the friction.

Pulley *i* is connected by a light aluminium stirrup with a wire *d* which passes round the double grooved pulley *w*, between two screws to prevent

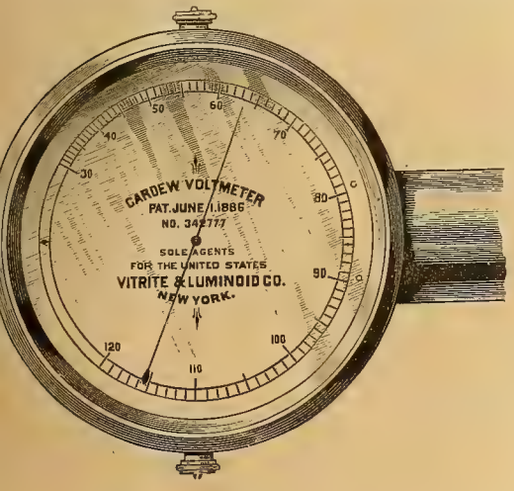


Fig. 59.

slipping, and is joined to a spiral spring J, by which all the wires are held taut by a yielding tension; this spring having an equal number of right and left turns to prevent torsion. The pulley *w* is connected by a gear wheel with the pinion *p*, to the axis of which is attached the index which moves over a scale graduated in volts as shown in Fig. 59. Two hairs, ⅛ inch apart, are stretched vertically across the stirrup of pulley *i*, and opposite these is a transverse circular opening through the tube, fitted with short tubes closed with glass, in one of which is placed a lens with a short focal length and a magnifying power of about 100 diameters, by which an image of the hairs is thrown on a distant screen by a lamp, for adjusting the instrument.

There is about 8 feet of wire included in the four lengths. Its resistance is about 30 ohms per foot, its maximum temperature about 200° C, and the indications of the instrument in volts is from 0 to 120. The expansion and contraction of the wire, being in direct proportion to the difference of temperature caused by the passage of the electric current, produces a variation in length proportioned to the e. m. f. by which the current is generated; this causes rotation of the pulley *w*, moving the index to the right as the e. m. f. increases and to the left as it decreases.

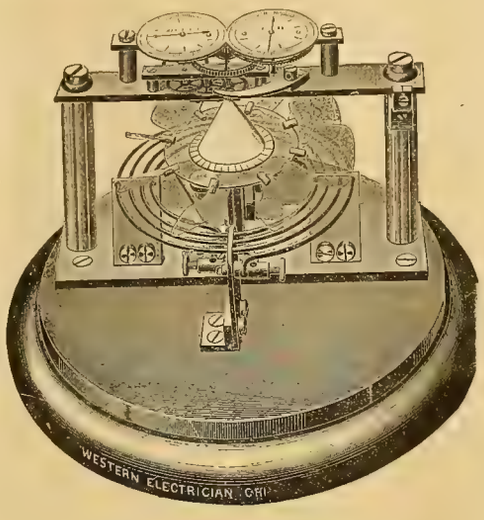


Fig. 60.

The instrument should be adjusted to the average temperature of the room in which it is to be used. It is claimed to be perfectly constant and never to require recalibration, that it can be kept in circuit continuously, and be safely used close to the most powerful dynamo, since it has no steel magnets or electro-magnets to become deranged, that it is dead beat, and that it responds promptly to very slight changes.

The Forbes Coulomb Meter.—The necessity for a meter which shall accurately measure the amount of electricity used by a consumer in a system of general distribution from a central station, has given rise to a variety of such instruments constructed on various principles; and this necessity has been made more imperative by the recent extended use of alternating current dynamos with transformers in connection; for which the meters used in the constant current system are not adapted.

The latest instrument of this kind, and one which has received the general approval of leading electricians is the coulomb meter of Professor Forbes, an English electrician. It is constructed on the principle of the production of air currents by difference of temperature caused by the heat generated in an electric conductor. The construction, which is exceedingly simple, will be readily understood from Fig. 60. On a circular base is mounted a flat coil of iron wire, through which the current passes by connection made with the binding posts shown in front; above this coil is mounted a light disk of mica, to the circumference of which are attached by pith cylinders eight mica vanes, which come directly over the coil, and are fixed at an angle of 45 degrees to the plane of the disk. The disk with its vanes is supported on a paper cone in the apex of which is a ruby cup which is pivoted on the point of a vertical rod fixed in the base; so that the friction is reduced to the minimum.

This cup is inclosed in a pinion connected with clock-work by which the speed of rotation is reduced and the indices moved over the dials.

The heating of the coil by the electric current generates an ascending current of air, and puts the light machinery in motion. A glass cover protects the instrument from external currents, a curved stop placed above the point of support of the disk is used to prevent injurious motion of the disk when the instrument is moved or carried about. The rate of consumption is registered by the indices on the dials. Each dial has ten divisions, and the indices, regulated by the clockwork to move at different rates of speed, indicate units on one and tenths on the other. The latest instruments have four dials, indicating respectively units, tens, hundreds and thousands. The English board of trade unit is the one adopted, representing the electric energy consumed by a 100 volt lamp, using one ampere of current, for ten hours, equal to ten ampere hours, valued at ten cents, and requiring 1000 revolutions of the mill wheel or disk. The consumption of lamps of greater or less voltage than 100 can be ascertained by multiplying by the voltage and dividing the product by 100. The instrument will work on a current of from ¾ of an ampere to 20 amperes, and will run 20 hours a day for five months at a time before the readings are exhausted. With from two to thirty lamps the speed of revolution is exactly proportional to the current, and by diverting all but one twentieth of the current from the meter through a shunt the same instrument can be used to measure with accuracy currents feeding from 20 to 600 lamps. This is done by the use of two meters, one used with the shunt and the other without it, and an auxiliary apparatus which allows the greater part of the current to pass through the second meter, connecting the two in parallel. This auxiliary apparatus is an electro-magnet with a coil of twenty turns connecting with the first meter, and of one turn connecting with the second; when the current is strong enough it pulls down a lever, which makes connection with the second meter and holds it there as long as wanted.

The absolute accuracy required in an instrument for close scientific measurement, is not necessary in an instrument like this, designed for commercial use; so that slight inaccuracies resulting from slowness of speed in starting, and others of a similar character, are of no practical importance where 1,000 revolutions of the mill-wheel indicate only one unit of electric quantity worth only ten cents. The inventor claims that practically the instrument is not affected by differences of external temperature or atmospheric pressure, or by internal accumulation of heat. The moving force is the difference of temperature between the conductor and the external air, and does not depend in the least on the absolute temperature of the place; the indications in a warm and a cold atmosphere are identical, and it is a matter of indifference whether the temperature at starting is 30° or 100°.

Ayrton & Perry's Ohmmeter.—This instrument is similar to the Ayrton & Perry magnetic ammeter already described, in which a needle is deflected by a coil carrying the current,

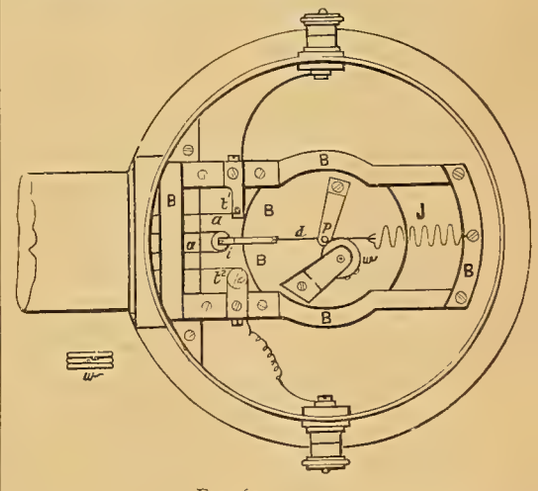


Fig. 61.

and brought to rest by a permanent magnet. In the ohmmeter an electro-magnet with a fine wire is substituted for the permanent magnet; the connections of the electro-magnet being the same as those of the voltmeter, while the connections of the coil which deflects the needle are the same as those of the ammeter; hence the amount of deflection depends on the ratio of e. m. f. to current and therefore measures the resistance between the two points with which the electro-magnet is connected, which is indicated in degrees on the dial, and then reduced to ohms by calculation.

Western Electrician.

EVERY SATURDAY.

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WITH this number a new volume of the WESTERN ELECTRICIAN is begun. Watch the paper during 1888. With success assured, and with additional talent and increased facilities in every department, the WESTERN ELECTRICIAN will be found still more interesting, pleasing and valuable.

Do not forget the banquet at the rooms of the Chicago Electric Club this evening at 8 o'clock. In addition to the lunch an interesting musical programme has been provided, and every member of the club should be present.

ON another page will be found City Electrician Barrett's estimate of the cost of lighting Chicago —between the lake and Halsted street, and Twelfth street and Chicago avenue—by electricity. The agitation still continues in the right direction, namely, toward the electric lighting of the city, and Prof. Barrett's estimate will be found interesting reading.

A DEVICE for using crude petroleum oil under steam boilers in place of coal for fuel is shown elsewhere. There are electric light plants in Ohio, Indiana, Pennsylvania, Illinois and southern California using crude oil for fuel and the subject is one that will interest all electric light companies, but more especially those who can readily and at a small cost obtain crude oil.

THE good the American Institute of Electrical Engineers in New York is doing the cause of electrical science will perhaps be better appreciated in the future than at present. Nevertheless, the fact must be as apparent to and as strongly impressed upon our readers as us that the scope of the institute's work is very broad and that the papers presented before it and the discussions hinging upon them are very valuable contributions to the electrical literature of the times.

THE telephone war in Rochester, N. Y., seems to be approaching the end. The executive committee of the Peoples' Telephone association met again last week and a sub-committee of four gentlemen was appointed to meet Colonel Parker, the Bell company's representative, look over the books of the company and obtain from the company its final rates. The main point of difference between the ex-telephone subscribers and the Bell company has lately seemed to be the amount that shall be charged for rental of telephones. The association has presented its schedule of flat rates and the Bell company has not seen fit to accept them.

THE dentists have found the storage battery well adapted to their use. A Chicago dentist who has tried it says that with a single cell and a small motor he can run his apparatus several days without exhausting the charge, and when recharging is required he has it done at a merely nominal cost by a dynamo in the building where his office is located.

Another dentist in the same building has put in a motor and made connection with the same cell to run his apparatus So that the two dentists get the power to run their apparatus for less than it would cost them for shoe leather with treadle and foot power, besides the saving in muscle, and the advantages of steady running and undivided attention to patients.

ONE of the brightest in name as well as in character of the New York papers, the *Sun*, recently discovered that "in the stylish up-town houses now it is impossible to see how the lady of the house communicates with the kitchen while a meal is in progress. This is because the call bell has become a mere electric button on one of the table legs, and she presses it with her foot whenever she wants the waitress."

The paragraph is going the rounds of the press with proper credit, and yet it causes a smile on the part of electricians, who regard the knee push or the floor, all as one of the minor applications of electricity of mature age. Nevertheless the widespread advertisement of this particular modification of the push button will do no harm to the business of electrical supplies men.

ACCORDING to J. M. Cattel, psychologists can determine by the aid of electricity the time occupied by our mental processes, or the time it takes to think. By causing a tuning fork vibrating at the rate of, say, 500 times a second to record its vibrations in a wavy line on a rapidly revolving drum, and dividing each undulation into twenty equal parts, time can be measured to the ten-thousandth part of a second. Adapting an electric current under the experimenter's control, to this device, the time between a sense-stimulus and its identification can be accurately measured, and is found to be less than .001 of a second. But it would seem that it is not the time occupied by the thought that is measured, but the interval between perception and reaction, simple or complex. The experiments do seem to prove, however, that thought is a comparatively slow process, and that the old adage, "quick as thought," does not express the rapidity commonly accredited to it. Electricity is infinitely quicker, and has the further credit of actually going wherever we wish, while thought is only thinking about going.

A Washington despatch of the 30th ult., says: Senator Cullom will introduce an amendment to his postal telegraph bill immediately after the reassembling of congress, changing the rates named in the original bill, more especially for the transmission of press matter. While he believes that congress ought to prescribe rates for the use of government wires, as it prescribes rates for the use of the mails, instead of leaving it to the discretion of officials, yet the rates named in his bill were designed merely as a suggestion to the committee which should have the bill in charge. With subsequent study, and with the information which has come to him from many sources, he has reached the conclusion that there ought to be no difference upon government lines between service of like character rendered to evening papers and that to morning papers. He says he appreciates the weight of the reason which leads private companies to charge more for day than night service—namely, the fact that the wires are in great demand for commercial messages at comparatively higher rates during the hours from 10 in the morning till 2 or 3 in the afternoon—but he believes that such reasons should not operate as regards governmental lines, and that the government should have no preferenced patrons as to rates for like classes of business, or as to order of transmission. The rates to be named in Mr. Cullom's amendment are based upon a unit of 100 words or fraction thereof, and are as follows: For 500 miles or less, 25 cents; between 500 and 1,000 miles, 30 cents; between 1,000 and 1,500 miles, 35 cents; between 1,500 and 2,000 miles, 40 cents; between 2,000 and 3,000 miles, 45 cents, and for more than 3,000 miles, 50 cents. When more than one copy of the same dispatch is sent to different newspapers at the same or at different offices the postmaster general is to prescribe the rates to be charged for the drop copies.

EDWARD WESTON, the electrician, is quoted as saying: "It is well known that the nitrate of amyl possesses the power of causing insensibility very quickly in a human being breathing its fumes. The effect is equivalent temporarily to a paralytic stroke. Now, nitrate of amyl is very cheap and plentiful. I propose to fire shells filled with this chemical instead of gunpowder. It will not be necessary to penetrate a ship. A few gallons of this nitrate dashed on the deck of a war ship would soon render her crew helpless. The most powerful ironclads would be even more vulnerable than the light cruisers, for they would be sucking down great draughts of air through their artificial ventilators, and the odor would thus rapidly permeate the whole ship. The entire crew being rendered helpless for an hour or two, the ship could, of course, be towed to a safe spot, while the captors ventilated her and removed the insensible men."

It has been a common remark of late years that a war between two powerful nations equipped with all the modern improvements in gunnery, would be simply butchery. We have the light mobile dynamite gun, a few shells from which would blow out of water the most heavily armored war vessel possible to construct, or if turned against a land force would quickly cause a carnage that words can not describe. We have swift torpedo boats designed to fly through or under the water to attack invading vessels, with their torpedoes and on the other hand have protected our ironclads with the electric search light, designed to warn against those swift, noiseless torpedo boats; but either offensive or defensive measures would result, with modern weapons, in wholesale butchery.

The electrician's method of warfare will strike the reader not only as feasible but also as humane. While the practice of a similar plan can be found in history, modern application presents new problems which Mr. Weston is readily able to solve.

VERY hopeful indeed were the 75 stockholders of the Keely Motor company who met in Philadelphia as noted last week and declared that "the chief difficulties have been removed and we are now in sight of the result." The same declaration has practically been made heretofore and usually has been accompanied by an assessment upon the pocket books of the stockholders.

Keely's accomplishments, according to his own testimony, become more wonderful as the years roll by. In 1882 he was employed upon the construction of a generator, designed to secure a vaporic or etheric force from water and air, to use the words of the article published. But this generator proved impracticable owing to the impossibility of securing graduation. In 1885 he produced a liberator which was to be used in conjunction with the generator and which he regarded as a great stride in advance. But since then he has made still greater advances for he shall not require either generator or liberator, or for that matter either vaporic or etheric forces, but has come across a new force the basis of which he says is "vibratory sympathy."

Keely seems to be doing very well in the way of discoveries. He keeps busy and out of mischief; seems to have the confidence of some of the stockholders in his company, who are willing to indorse that confidence with their money, and on the whole is harmless. No man of scientific attainments puts any faith in Keely or his motor, and both are standing subjects for jokes and jibes of the press of the country. So we will only record the reputed accomplishments of the past few years in Keely's line and then turn attention to another kind of force and another kind of motor, neither of which is so incomprehensible, so enveloped in words of mysterious meaning that it can not be understood by a child, both of which are practical and which are destined to take such complete possession of the field that when Keely's motor finally does arrive, its electric forerunner will have left no place for it.

Lighting Chicago by Electricity.

ESTIMATE BY PROF. BARRETT.

At the Chicago city council, January 3, Prof. Barrett (city electrician) submitted his report and estimate for an electric plant for lighting the city between Twelfth street and Chicago avenue, and the lake and Halsted street, which was referred to the committee on fire and water, and is as follows:

I have quite thoroughly investigated the various systems submitted relative to their fitness for the purpose, and have classified them under three general heads. Two of these are of the incandescent and one of the arc variety of electric light, and are known as:

1. The central station (incandescent) system.
2. The municipal (incandescent) system.
3. The arc-light system.

CENTRAL-STATION SYSTEM.

In order to thoroughly cover the needs it will be necessary that the capacity of the plant should equal an average constant demand of 75,000 16-candle-power lamps in use, with connections with at least the equivalent of 175,000 such lights. The following estimate is based upon a capacity of 75,000 lamps, averaging 840,000 lamp hours per day.

Plant.

Underground work, trenching, repairing, etc.	$ 1,000,000
Boilers, engines, steam-fitting, belting, shafting, etc.	400,000
Electrical appliances and machinery	550,000
Total	$ 1,950,000

Real estate, building, etc, for plant should be added to above estimate, unless property already possessed by the city could be made available—perhaps at the water works.

Daily Expense of Maintenance.

Coal, 210 tons, $2.50	$ 525
Breakage, 1002 lamps, 85 cents	852
Water, 10 cents per 1,000 gallons	35
Oil and waste	25
Removal of ashes	55
Meter department	50
Other official expenses	40
Twenty firemen, $2	40
Twenty engineers, $2.50	50
Twelve dynamo and regulator men, $1.50	18
Depreciation, repairs to dynamos and electrical apparatus	40
Depreciation, underground plant	50
Depreciation, steam	70
Incidentals not named above	20
Total	$1,870

One thousand eight hundred and seventy dollars is about the equivalent of gas at 50 cents per thousand feet.

THE MUNICIPAL SYSTEM.

The lights contemplated are of thirty candle power, but if desired there may be lamps of various candle power upon the same line. The electrical pressure in the municipal system is much higher than that in the Central station incandescent system, but is below that in the ordinary arc-light system. It is not a proper system to introduce into dwellings or other places where possible contact would be made by accident. In underground conduits or pipes, however, and handled only by experts trained in its use, it is perfectly safe and readily controlled.

Plant.

Dynamos, electrical apparatus	$ 19,800
Engines, boilers, etc	26,400
Underground conductors, delivered	16,500
Gas-post extensions	19,800
Superintending and sundry expenses	8,500
Conduits, incl. trenching and repaving,	442,698
Total	$533,698
Building for station, as above	8,000
Grand total	$541,698

Daily Expenses.

Coal	$50	Linemen	$ 5
Oil, waste, etc	3	Repairs	4
Engineer&electrician	10	Lamp renewals	40
Assistants	9		
Firemen	6	Total	$127

ARC-LIGHT SYSTEM.

This is the most simple of the systems, and is identical with that used by the city on the river, viaducts and bridges at Rush, Lake and Twelfth streets.

Plant.

Dynamos, complete, 750 double carbon lamps	$ 55,350
3,300 horse-power engines, boilers, pumps, heaters, etc, complete	30,000
750 posts, 16 feet high, erected	11,250
75 miles underground cable, with iron pipe, at $1,500 per mile	112,000
75 miles trenching and repaving and laying cable, as above	218,630
Rebuilding present station	8,000
Total	$435,230

Yearly Expenses.

Coal, 4,000 tons, $3	$ 12,000
Carbons	3,500
Oil, waste and incidentals	3,500
Chief engineer and electrician	1,500
Three assistants	3,000
Four firemen	2,400
Ten trimmers and linemen	6,000
Repairs	4,000
Total	$ 35,900

Assuming that there are 3,273 public and private street lamps within the territory named, and that each of these sheds 16 candle-power light, we have a total of 52,368 candle power.

With the incandescent system 3,273 lamps of 30 candle power each would give 98,190 candle power.

Seven hundred and fifty arc lamps would shed, at 2,000 candle power, a total light equivalent to that from 1,500,000 candles. Allowing for any possible candle power claimed, there would be still a large balance in favor of electric lighting.

It would seem from this that the illumination as between the incandescent and the arc is in favor of the arc, but the distribution is more uniform from the incandescent than from the arc.

The following table shows the comparative cost of the various lights, number, and candle power in the district designated:

Light.	*Number of lights.*	*Candle power.*	*Cost per Year.*
Gas	3,273	52,368	$61,756.26
Incandescent	3,273	98,190	46,730.00
Arc	750	1,500,000	35,900.00

Indiana Telephone Decision.

A despatch from Lafayette, Ind., dated January 3rd, says :

In the application of Susan B. Tulley for a mandate compelling the Central Union Telephone company, of this city, to supply her with a telephone and telephone connections at $3 a month, Judge Ventor has sustained the demurrers to the company's answers, holding that under the statute, the company was bound to furnish every abplicant with a telephone and connections at the statutory rate. One of the company's answers insisted that it was engaged in interstate commerce, and that the act of the legislature violated the constitution of the United States.

Other answers set up, in different forms, that it was not engaged in the business of renting telephones or of supplying private wires or private telephones to any one ; that the only form in which it undertook to serve the public was by means of what is known as the public toll system, under which the company established agencies or public stations at the residences, or business houses, of all persons to whom it supplied telephone service, and that all such persons were the company's agents, and that all individuals, on equal terms might, by paying 5 cents for each connection, use these telephones at such stations.

The court held that while the company might perhaps legally conduct business in this way, yet, as it was engaged in a general telephone business, it was nevertheless bound to supply every applicant for telephone connections and facilities at his residence or place of business, with a telephone and the necessary apparatus and facilities for placing him in connection with all the local patrons of the company, at $3 a month.

Thomson-Houston in the Northwest.

The enormous business done by the Western office of the Thomson-Houston Electric company, is a matter so well and so generally understood that it is almost superfluous to call attention to it. It is interesting, once in awhile however, to know what one of our largest companies is doing in a particular territory, and we therefore append a partial list of plants sold by the Western office of the Thomson-Houston company in the northwest, in the last sixty days. This office covers the west, northwest and southwest from Chicago, but we only mention the plants sold in the northwest.

In Minneapolis, the Crown Flouring Mill, the Columbia Flouring Mill, and The Galaxy Flouring Mill have all been equipped with incandescent lights. The Flouring Mills at Faribault, and St Cloud, Minn , and Sheboyan, Wis., have also been equipped with incandescent lights ; and the office of the Fargo *Argus*, in Fargo, Dak., and the new hotel in the same place have been fitted up with this company's incandescent apparatus. At Faribault, Minn., a large arc plant has been installed, and another at St. Cloud, Minn. At Albert Lea the arc light plant has been increased, and two hundred incandescent lights installed. At Watertown, Dakota, five hundred incandescents have been contracted for, and two hundred incandescents have been sold to Farwell, Ozmon & Kirk, of St Paul, Minn. ; another small plant of fifty arc lights might be mentioned at St. Paul.

Not satisfied with the showing already made, the company, as a crowning achievement and for the purpose, we presume, of properly rounding out the year, captured just before the close of 1887 what is probably the largest single order for arc light apparatus taken outside of their own company during the year just closed. The St. Paul Gas company has had several systems of arc lighting in use for the last year and a half and has been carefully watching the operation of each system with a view of deciding between them and adopting one uniform system to the exclusion of all others. The officers of the company at last passed judgment in favor of the Thomson-Houston apparatus and concluded that for economy and satisfactory operation the Thomson-Houston system was best adapted to their purpose. They therefore gave the Thomson-Houston company an order for six hundred and fifty arc lights, displacing with them that number of lights of various systems.

The Thomson-Houston company is to be congratulated not only because of this particular order but further because of its large and rapidly growing business in the west.

We have not space in this notice to refer to the large number of plants sold and sent out from the western office to the west and southwest, and are only able to give an example of the business done by this company by citing what has been done in the northwest. The Thomson-Houston apparatus is efficient and popular, and the business management of the company is energetic and pushing. The result is an enormous business, which is growing almost beyond the capacity of the company to keep up with it.

The construction work on the Thomson-Houston company's plants in the northwest is done by the Northwestern Electric Construction and Supply company, E. R. Gilman, Manager, St. Paul, Minn.

A New Military Balloon.

There is much mysterous talk in military circles of a balloon, the invention a M. de Villars, in which the problem of aërial navigation is said to be solved, at least to a degree never yet reached, says a correspondent of *Industries*. M. de Villars' aim has been to direct his balloon by taking advantage of the several air currents which are to be met with at various heights. To do this it is necessary to ascend and descend frequently in the course of a voyage. But with balloons of ordinary construction this is impossible, by reason of the loss of gas and ballast which such maneuvers occasion. M. de Villars has no ballast to throw away, and he is able to retain the whole of his gas. Here lies the invention, which is kept profoundly secret. The inventor has, it is said, sold his secret to the French government, to be used by it alone.

Electric Photometry.

By J. Swinburne.[1]

Candle power, as generally used, means nothing; and the candle power of a lamp strictly defined means the emission in a horizontal direction of a cylindrical carbon of the same surface held vertically.

This way of taking the candle power has the advantage of being simple, as most carbons are of circular section and horse-shoe or double loop form. If a horse-shoe carbon is held flatways towards the photometer it gives out the same light in that direction as it would if it were stretched out into a vertical cylinder. The same holds true with a looped carbon, if the carbon is so thin that the part in front does not sensibly shade a part behind.

The most convenient form of photometer is the Bunsen grease spot. Candles are not used in practice as light standards. The Methven screen or the Harcourt lamp is convenient. The Methven screen consists of a Sugg's referee burner, with a screen between it and the grease spot, the screen being pierced with a small rectangular hole. Photometers with Methven screens are made with the standard burner on a moving carriage. This arrangement is faulty: the lamp ought to move while the standard remains fixed. The Methven standard is wrong when the screen is close to the grease spot. Before using such a photometer it is necessary to calibrate the standard. The first thing to do is to mark off the scale for the lamp. If it is desired to measure lamps up to, say, 50 candles, the far end of the scale is marked 50, and the scale is divided up, the numbers marked varying as the square of the distance from the grease spot. This can be done rapidly with the help of a slide rule.

The pentane, or other standard lamp, is then placed on the mark corresponding to the light it gives. The Methven screen is then moved till it exactly balances the standard, and is fixed at that point. If any other standard is at hand, the referee's burner of the Methven lamp may be used. The screen is removed and the Sugg burner placed at a distance from the grease spot equal to that of the 16 candle mark on the other scale. The gas is turned up to the right height, and another gas jet of any sort is placed on the other scale and moved till it balances the standard 16-candle burner. The screen is now replaced, and the burner and screen are moved up till they balance the jet, and fixed there. Of course it is not necessary to make the screen exactly accurate to the Methven sizes if it is calibrated in this way. Any argand burner with a screen of the same sort as Methven's may be used and compared with a standard. These methods of calibration are accurate enough for ordinary work.

In installation work, what is wanted is to be able to run the lamps as bright as possible without breaking them, so that they run at the highest efficiency compatible with economy in replac ing. To get the best results it is obviously necessary that all the lamps should run equally bright, that is to say, at the same efficiency and same temperature. To make sure that the lamps all run at the same temperature they should be tested at the same efficiency, that is, the same candles per watt. Thus, unless the efficiency is stated, such an expression as 85 volt lamp means nothing; as a lamp might be run at any electromotive forces from 80 to 90, but would then run at different efficiencies. What are known as high efficiency lamps are simply small lamps tested bright; a similar lamp tested at a low electromotive force would be sold as a low efficiency lamp. After being sold the lamps might be run at electromotive forces different from those marked, and the so-called low efficiency lamp might be run brighter than the other, and would then really give a higher efficiency without getting credit for it. The efficiency is not a property inherent in a lamp, as many people seem to think, it depends only on the temperature at which the lamp happens to be running.

The photometer is, of course, provided with adjustable resistances, or secondary batteries may be used with switches for varying the number, for use in calibrating voltmeters. In incandescent lamp manufacture a wattmeter is used as well as a voltmeter and ammeter, as it saves a great deal of time; but for testing lamps, for instance, at an important central station the work can be done with only a voltmeter and an ammeter. The voltmeter should be put in shunt to the ammeter and lamp, not to the lamp alone, and the ammeter and the leads from it to the lamp should be without appreciable resistance. If their resistance is appreciable, the writer's method of compensation may be used. Part of the current circuit is wound backward round the voltmeter till there is no deflection when the lamp holder is short circuited, the voltmeter will then read the electromotive force on the lamp, though it is really not on its terminals. A fine wire in shunt to the ammeter is often convenient for winding these backward turns.

Before testing a lamp it must be decided what efficiency it is to be tested at. The writer generally takes .3-c. p. w. as the normal efficiency; some, however, prefer the lower efficiency of .25-c.p.w., or taking it backward, 4 watts per candle. The lamp is put at the expected candle-power, say 16, and run up by the switch till it gives 16 candles. The electromotive force and current are taken and their product multiplied by .3. If this gives 16 candles the lamp is running at .3-c. p. w., and may be labeled with the volts and amperes read. If too bright or too dull, a new reading is taken and new calculation made, and so on. A slide rule is convenient to make these calculations, but even then the process is very slow and tedious. The writer has designed a photometer scale which saves a great deal of labor. The index on the lamp-holder not only passes over the candle-power marks, but stretches across a broad scale. This is marked out with parallel lines running along it marked in volts. Thus for measuring from 40 to 120 volts there are 60 lines marked in volts. The tens and fives are made thick to be more easily seen. Curves really parabolic, are drawn to represent amperes cutting the volt lines at points such that all the intersections opposite any candle-power correspond to volt and ampere lines whose product is .3 of the candle-power. Thus, suppose the lamp, as before, runs at 16 candles; the voltmeter is read and the ampere line intersecting the corresponding line under the lamp index is noted. Suppose it is 1.4 amperes, if an ammeter shows, say, 1.3 amperes, the lamp is running too bright, and so on. This method, of course, requires no calculations.

Lamps supplied by the makers to run together need not necessarily give the same light or take the same current, but it is absolutely necessary for good work that they take the same electromotive force at the same efficiency, so that they will all run at the same temperature

If a lamp has a flat carbon a correction must be made. This is done best by opening one lamp and carefully measuring the carbon. The ratio of the surface exposed to the photometer to the surface that would be exposed were the carbon cylindrical is then calculated, and the Methven screen is moved forward a little to make the readings come right. The Methven screen instead of being absolutely fixed is made to move over a short scale. This scale is used for corrections for flat carbons, and for testing at efficiencies other than those for which the other side of the photometer has been graduated.

The photometer can then be used for testing at any desired efficiency without the calculating scale having to be altered.

Testing lamps to see that they all run at the same temperature is not enough for installation purposes; the engineer also wants to know which lamps are best, that is to say, which lamps will last longest at a given efficiency. People talk of the life of lamps in much the same way as they talk of their efficiency. The life of the lamp obviously depends on the way it is run and of the durability of the carbon. A good lamp on an installation where the electromotive force varies considerably on each side of the normal will not last as long as a bad lamp run on a circuit on which the electromotive force is kept constant.

No incandescent life tests of any value have yet been published. Tables giving lives, taken with considerable care and trouble have appeared, but in all cases there have been slips and omissions that render the data valueless. Sometimes the lamps have been run at different efficiencies; mistakes have nearly always been made in taking the candle-power, and the electromotive force has not been kept absolutely constant. We thus do not yet know what is the best efficiency at which to run well-made lamps.

It is not difficult to determine which of two or three types of lamp is the best. If the lamps are for parallel work, as is generally the case, two or more specimens are carefully tested at the same efficiency. If the electromotive forces required are not the same, resistance is put in series with those of low electromotive force till they can all be run together. They are then run in parallel and their lives noted. As this test may take a long time, and it may be inconvenient to get enough electromotive force to overrun them, it is a good plan to order a few lamps of slightly lower electromotive force than those in use on the installation.

In many cases it will be found that, instead of breaking, a lamp increases in resistance, thus protecting itself. A lamp that has increased in resistance may be regarded as broken, because such lamps are practically useless. If some of the lamps on an installation run dull they are practically useless, as it would pay better to replace them than to continue to run them. If many run dull, however, the chances are that the engineer will increase the electromotive force of the circuit to suit the dull lamps, so that the bright lamps break. If new lamps are ordered to replace those of the original electromotive force, they will be over-run. If lamps are ordered of higher electromotive force, the electromotive force needed on the installation gradually rises till the engine can go no faster. The result is that all the lamps on the installation are run dull, and therefore expensively. This is the reason why the lamps on old installations are generally run so dull; all the bright lamps have died out, and those in use are run dull.

A lamp that blackens may also be regarded as useless. People do not seem to realize what a little light a blackened lamp gives. It is strange that many engineers will buy what are called high efficiency lamps, and will then run them like hot hair pins, or blacken them till they give out something like two candles, still thinking they are getting high efficiency.

[1] London *Electrical Review*.

Telegraph Lines across the River Luan-ho.

The extension of the Chinese telegraph system has involved the crossing of several large rivers, a matter of no small difficulty, owing to the enormous dimensions of the summer floods. The river in question, whose ordinary width is about half a mile, is swollen by the rains to a breadth of more than eight miles, and quite recently a large village situated nearly five miles from the western bank was completely destroyed by the overflowing torrent. Heavy cables have been used for these crossings, but their lives have been of short duration, due partly to the debris brought down, partly to the constantly-changing river-bed. It was therefore decided to divert the land line some 19 miles, taking it to higher ground where the river was naturally more restricted as to its channel, and effect the crossing by means of a wire rope. The extremities of the rope at the position selected are respectively 447 and 737 feet above the level of the river, the distance to be spanned being 1,549 yards. The line is supported at either end by stout wooden posts some 14 feet high and 14 inches in diameter at the top. These posts are firmly stayed and guyed by steel ropes. In consequence of the exceedingly heavy strain it was found necessary to employ granite blocks about four feet in circumference as insulators. A similar wire rope crosses the river Kistna at Bezarrah, in the Madras presidency, having a span of 1,690 yards; there are two across the Ganges with spans of 966 and 943 yards; the Hooghly is crossed by a line of 711 yards; and in the United States a wire rope of 666 yards crosses the Missouri. The Chinese aerial line is consequently the second longest.

The wire rope was manufactured by Messrs. Siemens & Co., of London. It is composed of seven steel wires stranded, each wire .145 inch diameter.—*Ex.*

The Star Electro-Mechanical Gong.

The Star gong is designed for use on railroads, in fire department stations, factories, engine rooms, school houses, or other places where unerring alarms are requisite.

The mechanism is simple and its operation accurate. The release, controlled by the electro-magnet, is provided with an attachment which holds the hammer in position, except at the instant the current ceases, thus preventing more than one stroke for each pressure of the key. The hammer thus released falls into position for the blow, releases a stop-lever, and sets into motion a spring mechanism geared to a five-pointed star, one point of which forces the hammer to strike the blow. The hammer is faced with lignum vitae to mellow the tone of the gong, and the gong itself is cast in aluminum bronze. One winding of the spring—not clockwork—will serve 300 blows on the gong.

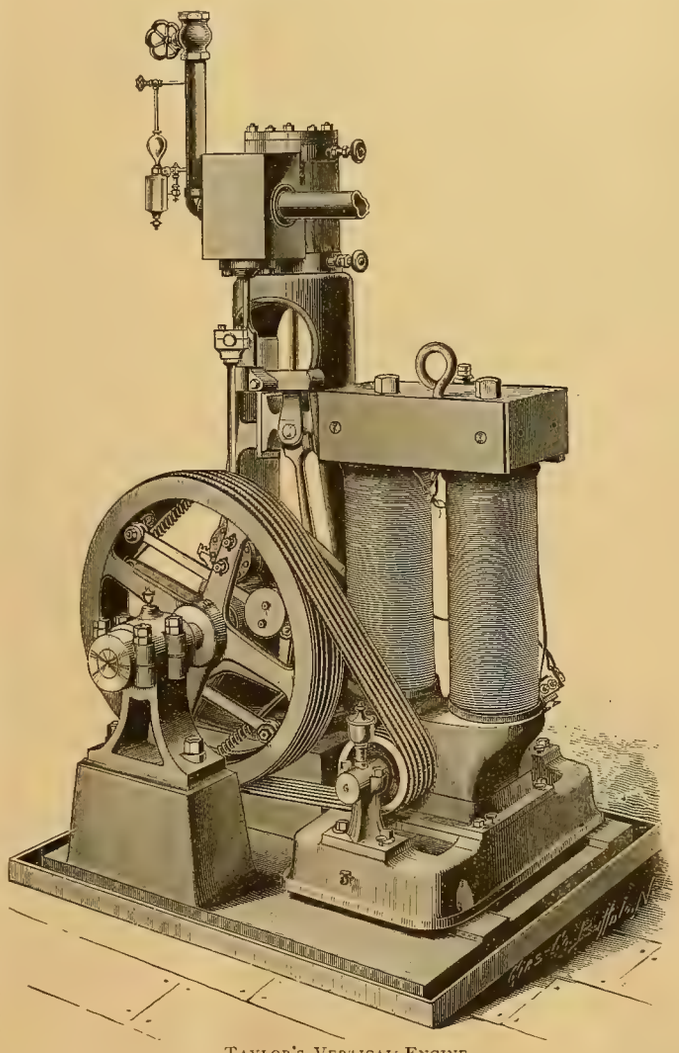
The magnets may be wound to any desired resistance, to suit the requirements of any circuit; and gongs of large size may be fitted for use on reversal circuits.

The instrument, as will be seen, is equally adapted for open or closed circuits It is weather proof, provided with lightning arresters, and mounted in handsomely finished cases of black walnut, ash, or cherry, with plate glass fronts.

The star gongs are made by the Electric Gas Lighting company, Boston, Mass.

Taylor's Automatic Cut-Off Eng ne.

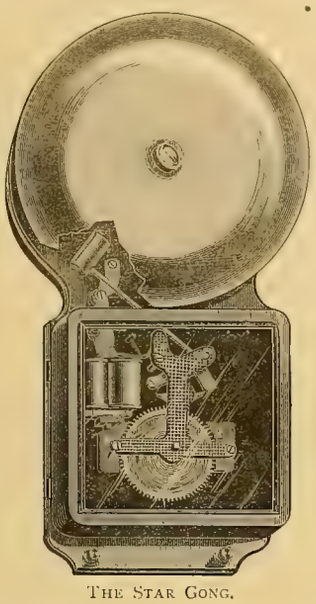
The accompanying cut illustrates the vertical automatic cut-off engine, on a combination base with a dynamo, as built by the Taylor Manufacturing Co., of Chambersburg, Pa. The same style of cut-off regulator is used on the vertical engine as on their horizontal engine, and is very simple in its action, which, being direct to the valve, secures close regulation in speed and economy in steam. One feature of special merit in the regulator is that it insures absolute freedom from "racing" of engine. The vertical engine is especially adapted for isolated electric lighting and purposes where space and power are limited; it is neat, durable and guaranteed to give excellent service. By the use of a special patent angular belt, there is no slipping, thus overcoming the objection to the ordinary round belt. The engine is built in four sizes, from 8 to 25 H. P.; the engine is also furnished without dynamo base for general service. For further particulars address the manufacturers.



TAYLOR'S VERTICAL ENGINE.

An Electric Piano.

One of the foremost of our firms of pianoforte makers has recently become interested in an electrical device which may become quite an important addition to the ordinary piano, even if it does not displace the pianist for all sorts of music. The device in question is the invention of a young telegrapher of this city, says the New York *Evening Post*, named Joseph Webber, who has been at work upon his idea for the last year, and has carried it so far that there is now no trouble about obtaining every facility for testing the experiment upon a large scale. The device itself is simple enough. For every note in the piano is provided a piece of soft iron wound with wire in the usual fashion, and capable of becoming a magnet when influenced by an electric current. Each magnet attracts a lever attached to a piano key, so that when a current passes to a particular magnet, the key corresponding to this magnet is acted upon and the hammer strikes the string more or less forcibly, according to the strength of the magnetic attraction. The wires running from the magnets



THE STAR GONG.

attached to each key center around a small cylinder provided with metallic pins, somewhat like the cylinder of a music box, except that the pins, instead of projecting from the surface of the cylinder, are perfectly flat. It is easy to understand how the current can be made to pass to a particular note only when a certain metallic point on the surface of the cylinder comes in connection with a comb, each metal tooth of which corresponds to a note in the piano. The chief difficulty to be met with was the problem of giving notes different dynamic values, one note being soft and the next note loud. This has been accomplished by introducing resistance coils into the circuits according to the power of the note wanted, and the tone can be graduated in a sufficiently accurate manner to allow some surprising effects.

Within the next two weeks there is to be an exhibition of the electric piano. The finished apparatus will probably not be sold for more than $100, being extremely simple in construction, and it will not be necessary to employ an expert in attaching it to an ordinary piano. It may be used in connection with any piano, but at the same time the ordinary key-board of the piano will be perfectly free, and the piano can be used just as if it had no electrical device attached to it. The apparatus will not affect the action or the tone of the piano. The cylinders to be used in the instruments now making will be six inches long and two inches in diameter—very small in comparison to an ordinary music box. Each cylinder will contain the equivalent of eight pieces of music of the average length, and the duplication of such cylinders is a matter of such simplicity that music in this shape will cost almost nothing. The apparatus will be so arranged that cylinders can be changed in a few seconds by any one. The motive power, or electricity, is astonishingly small, judging from the experiments already made, when the amount of tone gotten out of the piano is considered. So far as powerful playing goes, the electric piano will make an amount of noise greater than human hands, because every note on the key-board can be struck at once, if necessary. To do this amount of work, a battery of eight ordinary cells will be used, and in upright pianos there is plenty of room inside the case for the jars.

Chicago's Telephone Service.

Under the caption "Hello there, central," the Chicago *Herald* descants on the "incompetent telephone service," and piles up the agonies of Chicagoans in business, who make "much complaint about the grasping monopoly" that leeches their purses and abuses their patience. The first set of seven cuts, inserted in half as many columns of reading matter, are more laughable than artistic And the opening paragraph itself is more explicit than elegant. Here it is:

"The lessees and patrons of the 5,000 telephones in use in Chicago cannot much longer endure the service they are getting now. Bad from the very first, refusing steadfastly to grow in breadth of management as fast as its business grew, the Chicago Telephone company's service has finally become one of the afflictions that the city must shake off, or vastly improve, and at the same time lessen its cost." Nowadays it is far easier to send a messenger boy to do an errand, than to submit to the vexatious delays incident upon getting a telephone connection, and during certain hours of the day it is almost impossible to get the right connection. The quarters in which the Central Exchange is located, as well as most of the branch exchanges, are in buildings which are entirely too small, and the consequence is that one operator is obliged to attend more wires than he or she, however expert, can possibly control. This gives rise to much confusion in the way of mistakes. Thousands are called up who are not wanted, while in turn, as many more are given connections for which they make no application. And not only is this the case, but, if the statements of telephone subscribers can be relied upon, the discipline at the chief exchange is very bad. The girls by day and the boys by night have formed the habit of devoting too much of their attention to mutual gossip, and not enough to the demands of subscribers. This statement does not apply to all the operators. Some of them are competent and attentive, and with these it is a pleasure to use the 'phone, but so far as the statements of subscribers indicate anything, these are an exception to the general rule. Negligence and incompetency seem to be the general characteristics of the operators at the main office, as well as at most of the sub-exchanges."

After pointing out that the Chicago Telephone company is under the control of the Bell Telephone company; that the annual rental is $125

(for business house or private residence); and that the annual income is between $600,000 and $700,000, out of which the Bell Telephone company (which claims a monopoly of the telephone business in the whole country) draws from $50,000 to $75,000 a year by way of royalties, for the use of its instruments, besides owning 52 per cent of the Chicago company's stock, our seven-year-old contemporary boldly declares that, "therefore, the Chicago company exists only for the purpose of extortion," and says that "the demand is about to be made for a large reduction in rates and a substantial improvement in the service, both at the same time."

More funny cuts were subsequently published with interviews in abundance; and Mr. B. E. Sunny, superintendent of the Chicago Telephone company, was seen at his headquarters in the Pullman building, but the *Herald* interviewer simply attempted to be funny—a poor way of trying to benefit the public, except so far as his personalities may have produced a faint smile which may be quite as good as a bottle of some medicines. Mr. Sunny said, says the interviewer; "Out in Deadwood, there is a sign on a church door with a notice 'Don't shoot the organist, he's doing his best.' Now, I'm like that organist."

The Chicago *Tribune*, though playing second fiddle in this case, is nevertheless on the same trail, and pronounces "telephones a nuisance," and declares that "the Bell telephone monopoly cannot go on taking $400,000 a year of profit out of Chicago on a nominal investment and on an alleged patent right. The legislature must interfere."

The *Tribune* also published a large number of interviews, and finally, concludes that it has discovered the cause of the alleged poor service, in the under-payment of the girl operators employed by the company.

The officers of the company, on the other hand, claim that the girls are paid as well as girls employed in any other business requiring the same amount of skill, and further claim that the service is as good as can be given under the circumstances.

The *Herald* and *Tribune* seem to have lost sight of the fact that there may be more sense than humor in Mr. Sunny's reply to the interviewer's questions. The company is undoubtedly giving the best service it can with its present equipment, and at the present time it is spending thousands of dollars in increasing and bettering its facilities. In the first place it is putting up a large and commodious building, which will give accomodation to a much larger and more extensive switch board system, and the new switch boards have already been ordered.

The newspapers can judge as well as anybody else as regards the amount of money the telephone company is putting into its new building, but they may not perhaps be aware of the fact that it does not take a very large multiple switch board to cost any where from fifty thousand to a hundred thousand dollars.

The company is also going to great expense in putting a large number of its lines under ground and altogether seems to be making an earnest endeavor to get itself into shape to give its patrons efficient telephone service. All of the work, with this end in view, is being pushed as rapidly as possible, and Mr. Sunny is right when he says the company is doing all it can to better Chicago's telephone service. This being the case, would it not be fairness and simple justice to the company if the *Tribune* and *Herald* would wait and see what the service is after the foregoing improvements have been completed and put in operation?

The electric lighting of the Brussels exhibition of 1888, says the London *Electrical Review*, is to be equally divided between gas and electricity. Arrangements have been made to have the greatest possible number of systems represented. The principal English firms which have applied for spaces up to the present are the the Gülcher company, of London, Messrs. Bury, of Manchester, the Bernstein company, the United Electrical Engineering company, and the Anglo-American Brush corporation, of London. The Thomson-Houston International Electric company, of Boston, will also participate in the work.

The Formulæ of Dimensions in Electricity.

M. Lippmann, in a note in the *Comptes Rendus*, points out that the formulæ of "dimensions" in electricity afford a criterion of the maximum theoretical simplicity of any experimental method of measurement. In other words, the formula indicates the character of the measurment (of length, mass, or time) to be made, which is the necessary and sufficient condition for obtaining the numerical value of the quantity sought in absolute units. One or two examples will make this clear. (1) In absolute electrostatic units capacity has the dimensions of length. The principle which has been laid down leads, therefore, to the conclusion that there must be some, at least, conceivable method by which the capacity of a conductor could be determined in absolute units without the necessity for making any other than a single linear measurement; and this measurement must be numerically equal to the capacity sought. The following is M. Lippmann's solution. Suppose that we are required to determine the capacity of a Leyden jar. Imagine that we are provided with a metallic sphere whose radius can be varied continuously. We can then easily adjust the size of the sphere until its capacity is equal to that of the jar, and this can be done experimentally without requiring any operation of the nature of measurement. When, however, the adjustment has been effected, we know also that the capacity of the jar and the sphere, being equal, is measured in absolute units by the radius of the sphere. (2) Take the case of resistance, which has the same dimensions as velocity. M. Lippmann shows that it is possible to conceive a method of measuring resistance depending solely on the measurement of a velocity. Returning to the familiar though imaginary experiment in which a rectilinear conductor of unit length is supposed to move through a magnetic field of unit intensity in a direction at right angles both to itself and to the direction of the lines of force; we then say that if the slider form part of a circuit of unit resistance containing no other resistance than itself, unit current will flow through that circuit when the velocity of motion is equal to one centimeter per second. M. Lippmann now bowls over all these restrictions, and allows the experiment to take place with any length of slider, any resistance, and any magnetic field. He fixes attention, however, upon a point, P, situated at a constant distance from and in the rear of the slider, and in its plane, *this distance being equal to twice the length of the slider*. [It would seem that M. Lippmann exceeds here the limits which he assigns himself.] Now if a magnetic pole be placed at the point P, there will be a certain velocity of motion at which the magnetic field due to the current in the slider will at the point P exactly counterbalance the effect of the generating field, and consequently a small needle at this point would undergo no deflection. It can now easily be shown that the velocity of the slider is numerically equal to its resistance.—*London Electrician.*

Professor Urquhart has recently invented a portable electric lamp which he calls the "Sun," which is said to give a good all-round light for ten hours. It is fed by an accumulator with electrodes of "zinc and metallic alloy," which can be charged for a ten hours' supply in four hours, and maintained at a cost of 3d for six shifts of ten hours each. It is absolutely safe for use in an explosive mixture of gas and air, and hence well adapted to be used by miners, plumbers, and others who are brought into contact with explosive gases.

The lighting of private buildings by electricity in London is, though it may be slowly, yet surely progressing, says the *Builder*. Some of the houses in Kensington court are already lighted in this manner, and the electric current has now been extended to some houses in the neighborhood of Palace gate. The dull, dim light given by the gas supplied to London is inferior to that given by good mineral oil, and we shall be surprised if in a few years an enormous change in the domestic lighting of our large cities is not seen.

CORRESPONDENCE.

St. Louis Notes.

St. Louis, Mo., Dec. 31, 1887.—The year 1887 has witnessed remarkable developments and progress in the electrical interests of this city.

The electric light, telephone, telegraph and electrical manufacturing in St. Louis are far in advance of what they were at the beginning of the year.

The Heisler Electric Light company, which is now mainly devoting its energies to long distance incandescent lighting, is simply overwhelmed with business. An extension of the factory facilities of the concern is contemplated.

Mr. Chas. Heisler is the pioneer electrical manufacturer of St. Louis, and is the president and proprietor of the following companies: The Heisler Electric Light company; the St. Louis Illuminating company; the American Carbon company, and the Heisler Electric Bell and Burglar Alarm company.

Mr. Heisler has built up a business of important proportions in this city, and his shipments of apparatus are large and go to all parts of the country. The Heisler long distance incandescent light system is finding special favor with consumers, and the local Heisler companies are all said to be profitable. Mr. Heisler has some most flattering testimonials from towns where his long distance system has now been in use from a year-and-a half to two years, and we all know that the system is a great success as operated in this city by the St. Louis Illuminating company, which has burning nightly more than one thousand lights.

The Parker-Russell Mining and Manufacturing company, are making large shipments of their well-known sunlight carbons. The excellence of these carbons, and the remarkable activity in the electric light field, keep this concern pushed to the utmost to keep up with their orders.

The Pond Eugineering company, which makes a specialty of installing complete electric lighting plants, has a number of heavy contracts on hand. This concern is noted for the general excellence of its work.

The St. Louis Battery Manufacturing company have located in new quarters at 807 Locust street, where they are very comfortably situated on the ground floor.

Mr. P. C. Burns is the manager of this company and one of their specialties is the microphone battery. This battery is being extensively sold throughout the West, and is said to have long life and great strength.

Rose & Rein have also moved, their old factory having proved inadequate, and increased facilities having been found necessary. They are now at 322 North Second Street, where they have two spacious floors well fitted up with machinery for special manufacturing.

The Shultz Belting company finds their business in fulled leather belting for electric light purposes steadily increasing, and the order books of the concern make a splendid showing. Mr. Shultz early began cultivating electric light trade, until now it is one of the most important sources of his orders.

The business of the St. Louis Western Electric company is steadily increasing and more apparatus will soon be put in place. K.

From the Pacific Slope.

San Francisco, Cal., Dec. 22.—Alameda City runs eighty lights for street use, and five private lights for stores. The private lights will be discontinued on the first of the new year, as it does not pay to run through moonlight nights.

New underground lines have been laid for the Oakland mole electric block signals.

A Brush electric light plant has been installed at San Rafael by the California Electric Light company.

Mr. Claus Spreckels has completed all arrangements for a $500,000 Beet sugar evaporator, to be built at Watsonville, Cal. The building is to be lighted by the Incandescent light, and electric fire alarm and signals are to be used throughout. The large sugar refinery at South San Francisco has 1,250 Edison lamps and four dynamos. They

are also making arrangements to put in electric motors to haul the sugar up from the docks. This work is now being done by a donkey engine.

The Jenney Electric Light company, of Indianapolis, Ind., has asked the Oakland council for a franchise to erect electric light poles and lines, and to maintain lights in Oakland, Cal.

The Western Union Telegraph office at Oakland will be moved into new quarters in a few days.

The Postal Telegraph company have formed a good business in Oakland.

A plant of the American system has been installed at Santa Clara by the Electric Improvement company of this city. Lights were started on the night of the 21st to the delight of the residents of that beautiful but dark city.

The cars for the electric road at San Jose are not expected at that place before the middle of January, and the dynamos are to arrive about the 1st of January, and consequently the road will not be started until about the middle or latter part of January. The cars are made by the Pullman Car company.

Representatives of the Electric Development company have gone east to make arrangements for machinery for their new works. S.

ELECTRIC LIGHTING.

About five miles of circuit for the river lighting plant in Chicago have been laid, and a dozen or twenty lights have been put into use.

The Hauss Electric Lighting & Power company has organized at Cincinnati, with a capital stock of $250,000. Fred Hauss is president, and Fred Alms and Julius Balke are in the company. They will erect a plant at 16th and Plum streets.

The Kanawha, W. Va., Electric Light company has contracted to light Charleston.

The Durham, N. C., Electric company contemplate putting in an alternating plant.

C. P. Poole will erect an incandescent electric light plant at Lynchburg, Va.

Seward, Neb., will introduce the electric light.

The amount appropriated for lighting New York city for the coming year is $632,000, and $12,000 for 1,000 additional electric lights.

Three of the Newark, N. J., fire alarm boxes were burned out recently by currents from the electric light wires.

W. Y. Wark, of the Pike Electric company, of St. Louis, Mo., has organized a $10,000 stock company to erect an incandescent electric light plant at Pine Bluff, Ark.

H. H. Corson, representing the Thomson-Houston Electric Light company, has formed a stock company to erect a plant at Morristown, Tenn.

The Alton, Ill., Gas & Electric Light company, has contracted to light that town at $27 per lamp a year for gas lights, and $100 per light a year for electric lights.

The Virginia Electric Light & Power company of Richmond, will shortly begin work upon the erection of its plant.

The Rappahannock Electric Light and Power company, of Fredericksburg, Va., is doubling the capacity of its plant.

W. A. Wright, representing the Brush Electric Light company, is negotiating for the erection of a plant at Greenville, S. C.

Anna, Ill., is to have an Edison plant of 225 twenty candle power lights in operation by February 1st.

The Winfield Gas company of Winfield, Kan., have ordered a Thomson-Houston arc and incandescent plant.

The electric light plant at Arkansas City, Kan., was started December 10th. Its operation was eminently satisfactory.

Barrton, Kan., was lighted by the electric light December 8th for the first time, and the local paper signalizes the event by the use of display type liberally distributed through a triple head.

THE ELECTRIC MOTOR.

The committee appointed at the last meeting of the board of trade for the purpose of considering the feasibility of establishing in this city a central station for the distribution of electric power for manufacturing purposes, met at the board of trade rooms last evening, says a Topeka, Kan., paper of recent date.

Mr. Elliott, representing the Sprague Electric Railway Motor company, was present and explained the system in full, the substance of which is as follows: The cost of the power in Topeka at present, on a basis of ten hours per day, including the interest on money invested in engine and boilers, buildings, insurance on boilers, etc., is as follows:

5	horsepower plants	$200	per horsepower
10	" "	160	" "
15	" "	120	" "
20	" "	100	" "
25	" "	82	" "
50	" "	60	" "
75	" "	51	" "
100	" "	42	" "
150	" "	35	" "
500	compound and condensing engine.	30	" "

When the factories are within a radius of one mile, and when the power is generated by a 500 horse power compound condensing engine, and transmitted by electricity, the saving is as follows on the yearly expenses:

Units of 150 horse	$1,000,	or 20 per cent.
Units of 100 horse	1 200,	or 27 per cent.
Units of 75 horse	1,500,	or 41 per cent.
Units of 50 horse	1,500,	or 49 per cent.
Unite of 25 hurs:	1,300,	or 61 per cent.
Units of 20 horse	1,600,	or 71 per cent.

If the factories which are about to be established would locate at one point, and each factory be a stockholder in the power plant, in proportion to the power they consume, they would be able to get their power at the greatly reduced cost and have steady and reliable power. The 500 horse power compound condensing engine of the most improved construction, would drive the dynamos which would generate the current to drive large sized motors situated in the several factories, thus constituting a perfect system of power distribution at the lowest possible yearly expenses. Another feature in connection with this project is that the factories can be lighted from the same wires that carry the power to the motor, thus bring the cost of light to the lowest figure. By each factory being a stockholder in the power plant, they will all receive directly the immense saving of this system. Owing to the fact that all the members were not present, no action was taken.

There is much truth in this excerpt from the current number of the *American Machinist*:

"There is, no doubt, plenty of room for small electric motors; plenty of places where they may be used to excellent advantage, and where other means of driving would be impracticable. But the introduction of electric motors is very likely to be delayed by over-statements of their efficiency as compared with that of the steam engine driving direct. In a recent article in a daily paper, evidently prepared by someone who knew nothing about the subject, and with the unconcealed intention of 'booming' electric motors, the friction between the steam engine and the work to be done by it is put at eighty-five to ninety per cent. of the power of the engine, eighty-five being the minimum. Now, anyone at all acquainted with such matters knows that a loss of eighty-five per cent. in the power developed by a steam engine in getting that power to the work to be done, not only represents very extreme conditions, but generally poor engineering. And when this argument is advnnced to prove that it is better to use fifty electric motors in a building, driven from a central station perhaps two miles away, becanse the loss of power will be less than with an engine in the building, the verdict is likely to be that those who use this argument are dishonest or ignorant. There is no way to discredit any mechanical arrangement more effectively than to make gross misstatements about something that competes with it. The electric motor should be introduced on its merits, then it is likely to succeed."

The executive committee of the Brussels exhibition of 1888, intends to provide a service of small electric tramways worked on the accumulator principle, each car carrying 10 or 14 persons. These will probably be provided and worked by the Jablochkoff company, the Thomson-Houston company, and A. Reckenzaun.

THE TELEGRAPH.

A Berlin telegram of Tuesday last states that the bill for the purchase, by the State, of the present telegraph cables between Germany and England will be brought forward in a few days. The expense of the transfer is reckoned at about seven millions of marks. Immediately after the nationalization the Anglo-German tariff will be considerably reduced.

The Western Union Telegraph company in Chicago employs 137 boys as messengers. They are under charge of W. G. Frazier, who began as messenger in 1867, and has advanced through the different steps of promotion to his present place, to which he was assigned in 1881. The American District Telegraph company has in service about 100 boys as messengers. They are divided among the nine company offices, located at different points, the central office, on La Salle street, retaining the majority. The force is divided into two sets, one for day work and the other for night. The pay is $17 a month for new boys, $19 after they get well settled into the requirements, and $20 a month after the first year. The average age of the boys is fourteen years.

Senator Sawyer, chairman of the senate post office committee, says he will bring the subject of the postal telegraph before the committee very early after the holiday recess, and he expresses the opinion that the committee will set about the study of the question involved at once. He does not know whether it will be necessary to open the doors and hear arguments from parties who favor or oppose governmental interference with the telegraph. There is already, he says, a vast amount of literature on the subject, and, personally, he has heard enough, as he doubts not Senator Saulsbury has, to enable them to reach conclusions for themselves. Both were members of the post-office committee of the forty-eighth congress when the subject was studied exhaustively. Five members of the present committee were members of the forty-ninth congress, which reported a telegraph bill, but did not repeat the extensive investigation made by its predecessors. Senator Sawyer is noncommittal respecting his own predictions. He supported the bills reported by the forty-eighth and forty-ninth congresses, which looked to the establishment of a postal telegraph system, but with the cöoperation of private corporations.

The Knights of Labor have adopted the Cullom postal telegraph bill and are signing petitions to congress to pass it. Some monster petitions in favor of the bill are expected after the recess of congress.

Captain Stephen G. Sluyter died at Hartford, Conn., December 26th. He was engaged for several years in soundings preliminary to laying the Atlantic cable, and was in command of the steamer Victoria, when she laid the cable in 1858.

At the meeting of the town council of Glasgow, Scotland, December 12th, it was resolved as to the lighting of the bazaar and city hall, that the tender of R. Miller—Thomson-Houston system—should be accepted. One member asked whether the committee had satisfied themselves as to the safety of this system, as he was informed that it was not so safe as others, and remarked, "With some systems you could take both wires in the hand, but with this one it meant instant death." To this another member replied, "The wires are no' for takin' in the han's at all."—*London Electrical Review.*

The new electric light plant for Albany, Ore., has been shipped from Middletown, Conn. It consists of a complete 45-arc light, the dynamo, regulator, lamps, wire, etc. An incandescent system will be constructed at the same time that the arc plant is erected. The plant will be one of the most complete on the coast and will cost $15,000. It is expected to have the lights in operation on February 1st.

Miscellaneous Notes.

A New York inventor has devised for the use of firemen an electric lamp and belt, the latter containing cells and a battery. It is claimed that this contrivance will give all needful light, even in the densest smoke.

An Austrian physicist, H. Mach of Prague, has made some interesting experiments on photographing rifle bullets in motion by means of the electric light. In doing this he illumines the bullet by letting it break an electric current formed, but the velocity of the bullet must exceed that of sound, in order that the conditions of the air before and behind the projectile can be shown. After many experiments, Herr Mach succeeded in photographing projectiles fired by Mr. Wernal and Mr. Jurde's guns, having respectively an initial velocity of 438 and 530 meters per second. The photographs thus obtained showed an air formation in front of the bullet having the form of an hyperbole, whilst behind it almost a vacuum was formed, in which, when the initial velocity was very great, there were some curious spiral motions. On the whole, there appeared from these photographs to be a great similarity between the motion of a body through the water, and that of a projectile through the air.

Recently experiments in blasting by electricity were carried out at Ynyshir, in South Wales, the representatives of some 5,000 miners being among the spectators. These gentlemen unanimously passed a resolution cordially congratulating the proprietor and the manager of the Standard colliery, Ynyshir, for having effected such an important reform, which would, if generally adopted, render a great additional protection to thousands of miners. An electric lamp carried by the manager came in for a great share of attention and praise.

A large works for the production of aluminium in connection with Castner's process for the manufacture of sodium has been begun at Oldbury, England.

An English paper states that the prison authorities have decided to consult the electrical engineering profession as to the possibility of utilizing the treadmill power which at present is allowed to waste.

At a recent meeting of the English Royal United Service institution, says the London *Electrical Review*, C. F. Henwood expressed the opinion that ships can be protected from the troublesome barnacle depositions on their bottoms by means of zinc sheathing so applied that the electro-positive zinc comes in contact with the electro-negative iron or steel; galvanic action being thus established between them, the zinc would be thus perpetually disolving away in an oxide, and carrying away with it the barnacles and other zoophytes, leaving a clean surface, and that iron or steel ships so sheathed with zinc might navigate the seas as free practically from fouling as our copper-sheathed wooden ships.

Despite contrary reports, says *Fire and Water*, the Calumet and Hecla copper mine fire appears to be still burning. A dispatch from Calumet, Mich., Dec. 24th, reported another slight cave-in, when the amount of smoke which arose from the opening is said to have convinced the most unbelieving that the fire had not yet been extinguished. It is understood that the company has succeeded in getting through by rail a large quantity of the materials for the manufacture of carbonic acid gas, and will continue to fight the flames on the old lines.

The Independence, Mo., Electric Light company are preparing to put up a new building, 30x60 feet, especially adapted to their purposes, just east of the site of the present plant. Two sixty horse power engines will be put in the new building, also a dynamo for arc and another for incandescent lights. The company now have more orders for arc lights than their present engine will supply. The new engine will, however, be in place in a few days.

Ionia, Mich., talks of purchasing an electric light plant.

The electric light plant for Trinidad, Colo., has been ordered and is expected to be in place in sixty days.

Business Mention.

The Electrical Supply company, Chicago, are selling an electric light wire, which they call P. & B. weather proof wire. A great many advantages are claimed for it.

At the recent exhibition of the Massachusetts Charitable Mechanics' association, the Waterhouse system received the gold medal for electric lighting apparatus. The judges' report on which the government voted the gold medal was in substance: "The remarkable test of the capacity of the apparatus in governing arc lighting circuits, and also the peculiar use of magnets, both requiring the exercise of a high degree of inventive skill and applied science of great value." Considering that the judges were electricians this must be very satisfactory to the Waterhouse company, especially because it was their first competitive exhibition.

A New York Press despatch of the 26th ult., indirectly pays the Western Electric company a handsome compliment, inasmuch as that company is the builder of the board described. The despatch reads: The largest, best equipped, and most costly electric switch-board in the world is just being completed in the Metropolitan telephone company's building, 18 and 20 Cortlandt street. The officers of the company have combined the switch board in one mammoth board. Over two hundred patents have been utilized, including several of T. N. Vail's, seven or eight of J. A. Seeley's, a couple of T. R. Doolittle's, twenty of C. E Scribner's, and the rest divided among scores of other electricians. The board as it now stands cost $32,000. To assure himself that nothing worth incorporating had been missed, Mr. Vail invited E. H. Metzger of Pittsburg, C. E. Scribner, E. M. Barton, and B. E. Sunny of Chicago, W. F. Wilson of Columbus, Thomas L. Lockwood of Boston, William Wiley Smith of Kansas City, H. L. Ladd of California, and other experts in such matters to come here and consult with Mr. Seeley. The conference took place last week, ending in a banquet given by Mr. Vail at the hotel Brunswick Thursday night. The switchboard, or boards, as it is divided into four sections, will accommodate six thousand wires, with a capacity of ten thousand when wanted. The board is nearly three hundred feet long. To make connections in the office over a million joints had to be soldered in wires, and three thousand miles of wire were used.

The Electric Gas Lighting company of Boston, has just received advices from its European agents, the Woodhouse & Rawson Electric Supply company, that at the American exhibition, London, Eng., it received the highest award (diploma of honor) over all competitors for its exhibit of electric gas-lighting apparatus, annunciators, burglar alarms, electric bells, etc.

James W. Queen & Co., 924 Chestnut street, Philadelphia, Pa., well-known for carrying a large and well assorted stock of physical and chemical apparatus, have recently issued several new catalogues covering new instruments.

The friction clutch department of the Link-Belt Machinery company of Chicago is crowded with orders, many of which are from patrons who have tried the clutches for which this company is famous and are so well pleased that they must have more. For electric light plants no clutches are better adapted.

Telegraphic communication with the Island of Antigua, which has recently been interrupted, is now restored. The cable between Trinidad and Demerara is still interrupted.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	390
Central Union	44	45
Michigan	73	74
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	28	30
Missouri and Kansas	68	69

Personal Paragraphs.

A. H. Brown, for some time connected with the Chicago Arc Light and Power company as electrical engineer, has resigned in order to unite himself with Leonard and Izard. The scope of the new position is broader and better opportunities for advancement are offered Mr. Brown.

The superintendence of the Chicago Telephone company, vacated by Mr. Sunny will devolve upon Charles Wilson.

Electrical Patents.

375,328. Commutator or electric circuit-breaker. Chauncey D. Baker, Chicago Ill.

375,339. System of synchronism for telegraphy. Gilbert A. Cassagnes, Paris, France.

375,346. Electrically propelled vehicle. Stephen D. Field, Yonkers, N. Y.

375,390. Portable electric coal mining machine. John B. Sneathen and Albert Michaels, Pittsburgh, and Moses A. Michaels, Allegheny, Pa.

375,392. Electric meter. William A. Stern, Allegheny, Pa,

375,403. Automatic rheostat and contact point. Addison G. Waterhouse, Hartford, Conn.

375,408. Calelectric generator. Edward G. Acheson, Pittsburgh, Pa.

The invention is based upon the discovery that if the "magnetic whirl" is produced in or about an electric conductor which is traversed by currents of heat, an electric current will be generated in said conductor at each establishment and disestablishment of such magnetic whirl cutting said conductors.

375,414. System of electric gas-lighting. William H. Dœring, Philadelphla, Pa.

375,441. Galvanic battery. Harry B. Cox, Cincinnati, Ohio.

The invention relates to the battery excitant and the process of preparing the same.

Irish moss is soaked until it begins to ferment, after which it is boiled, salammoniac being gradually added. Afterwards a small quantity of bisulphate of mercury is added.

375,442. Hotel signal. Harry B. Cox, Cincinnati, Ohio.

354,456. Telephone. Edward C. Newton, Little Rock, Ark.

375,476. Electrical cut-out device. J. Chester Chamberlain, New York, N. Y.

375,542. Electric l converter, motor and generator. Rudolf Eickemeyer, Yonkers, N. Y.

375,543. Electric circuit changing and signaling apparatus. Isaiah H. Farnham, Malden, Mass.

The invention relates to village telephone exchange systems. A distant station connecting with the village system by a trunk line may unite itself with any predetermined circuit of the system. There are thirteen claims.

375,544 Electro-magnetic arresting and releasing mechanism. Isaiah H. Farnham, Malden, Mass.

The invention relates to controlling clockwork motors and like mechanism.

375,559. Galvanic battery. James F. McLaughlin, Philadelphia Pa.

375 56 . Electric motor. James F. McLaughlin, Philadelphia, Pa.

375 561. Primary electric battery. James F. McLaughlin. Philadelphia, Pa.

The carbon and zinc give elements are separated from the exciting fluid by a horizontal porous diaphragm. There are ten claims.

375,569. Automatic cut-out for fire-alarm box controllers. Charles D. Rogers. Providence, R. I.

375,614. Sparker coil for gas-lighting. Rudolf Eickemeyer, Yonkers, N. Y.

375,617. Electric call box Leroy B. Firman, Chicago, Ill.

The invention relates to combined police and fire alarm boxes. The first claim is as follows: "The combination, with a call-box having an exterior lock, of two or more keys, either of which will unlock the box and one or more of which are given a different configuration to engage and move a shifting device; constructed to change the signal sent in by the box substantially as specified."

375,633. Underground Electric Conductor. DeWitt C. James, Warren, Pa.

375,649. Railway-signal. Austin B. Patton and Robert S. Connor, Park City, Utah.

375,676. Electric motor. Edmond Julien, Brussels, Belgium.

375,685. Double spring loop, key and circuit for multiple switch boards. Charles E. Scribner, Chicago, Ill.

By means of a single loop switch the operator at the central office is enabled either to bring her telephone into a single line, and at the same time provide a ground connection, or to loop her telephone into a pair of cords connecting two subscribers' lines, in the latter case cutting off the central office ground as is necessary.

The switch is provided with three springs which may be brought into either of three positions by a cock-lever.

A retardation coil and battery are included in a wire between one of the springs and ground, and the circuits are so arranged that when one plug of a pair is inserted in a spring jack, the other may be used for testing.

375 697. Tension device for winding electro magnets. James W. Easton, New York, N. Y.

375,702. Flexible standard and conductor for electric lights. Ernest C. Fasoldt, Albany, N. Y.

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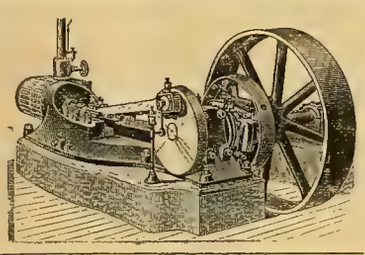

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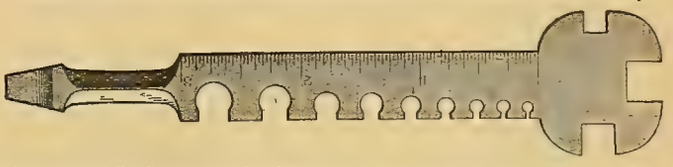

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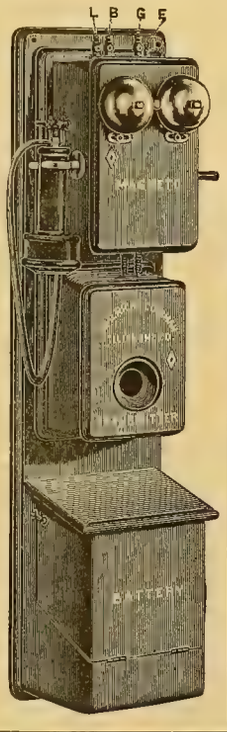

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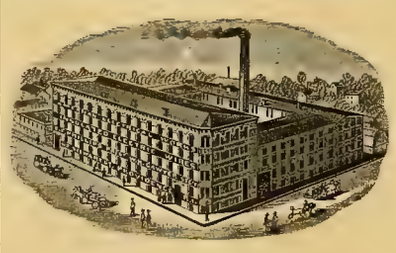

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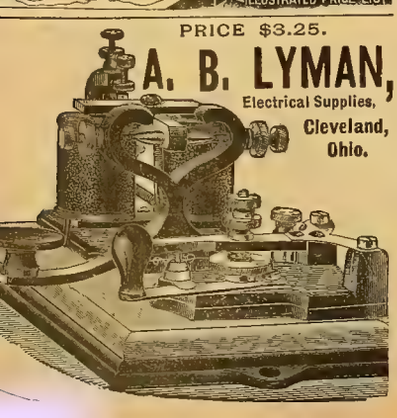

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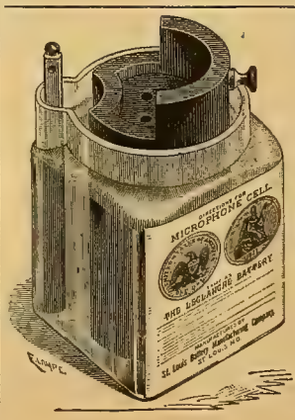

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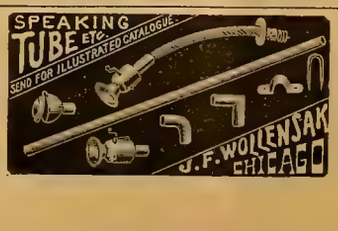

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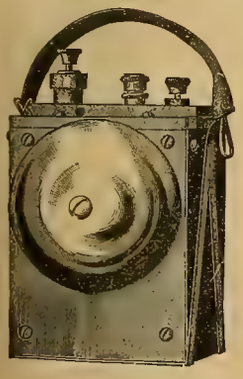

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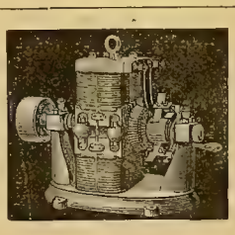

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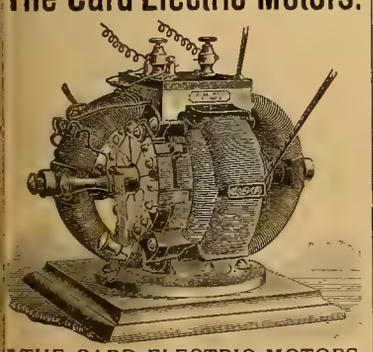

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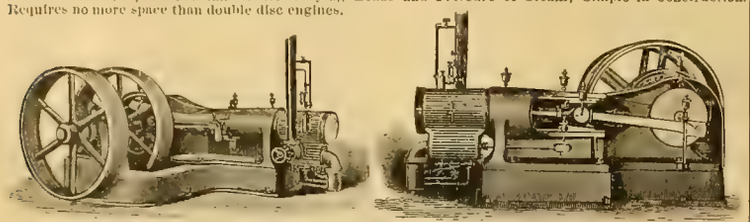

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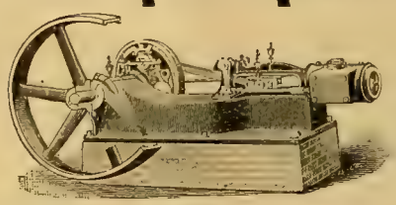

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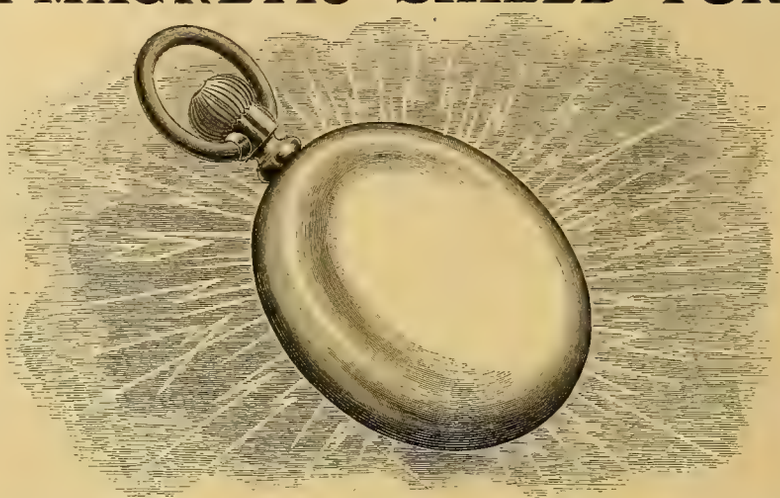

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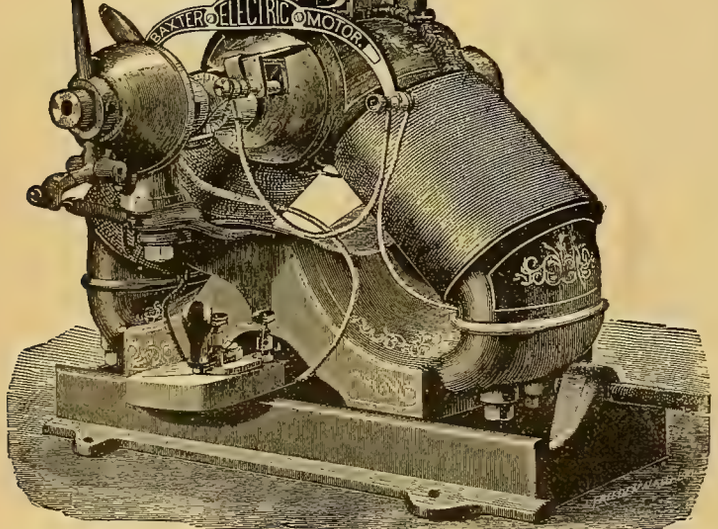

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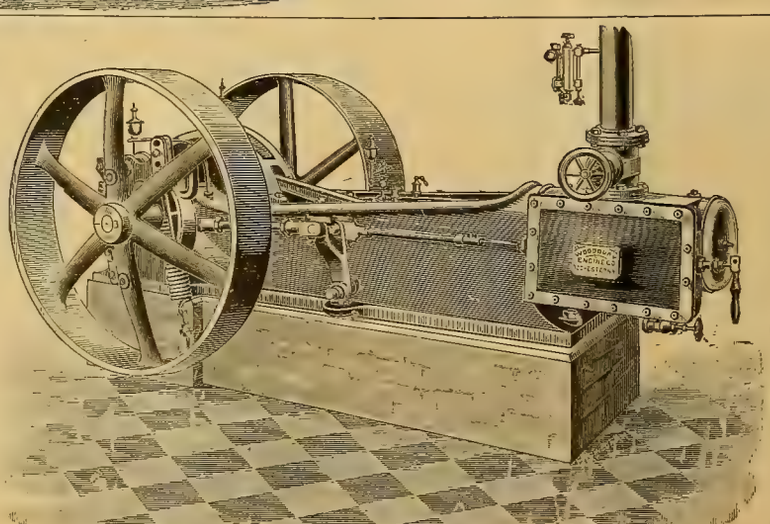

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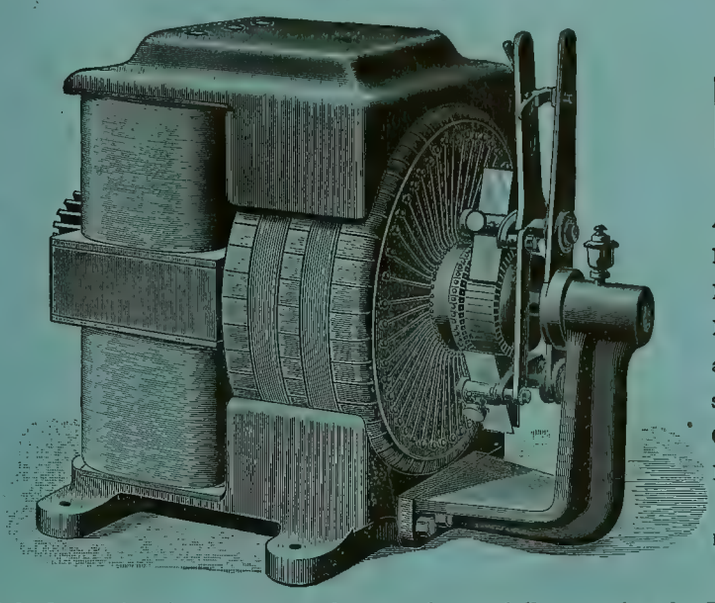

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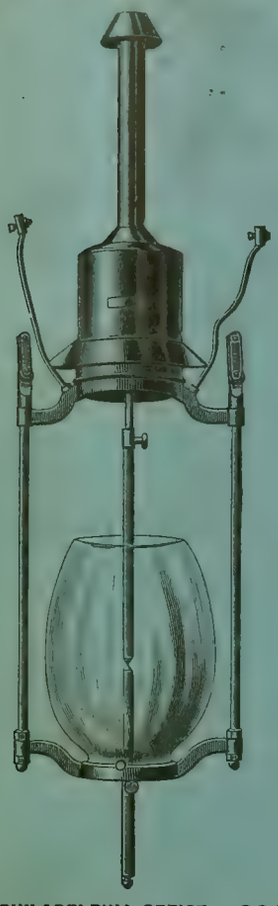

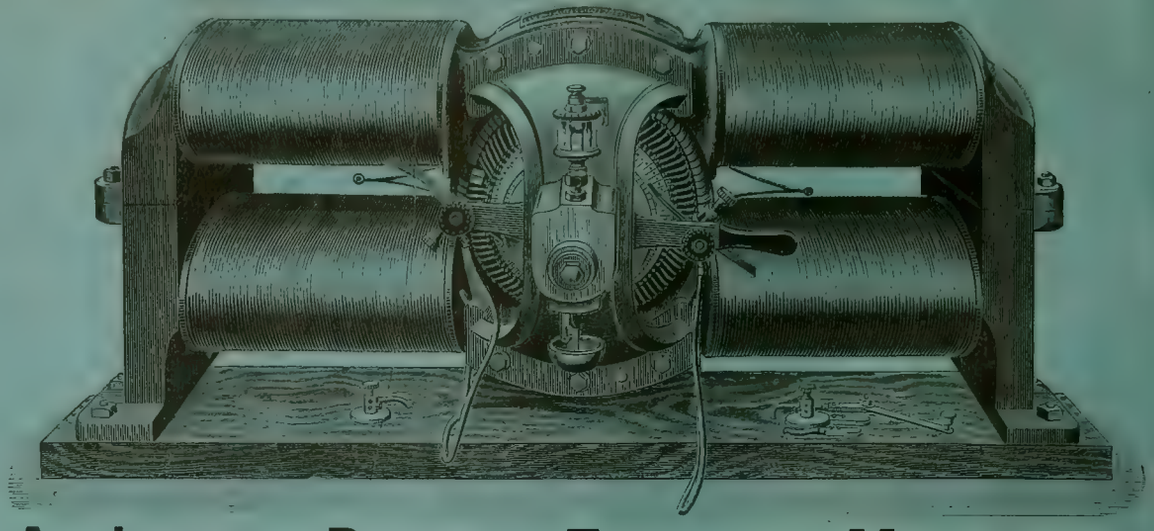

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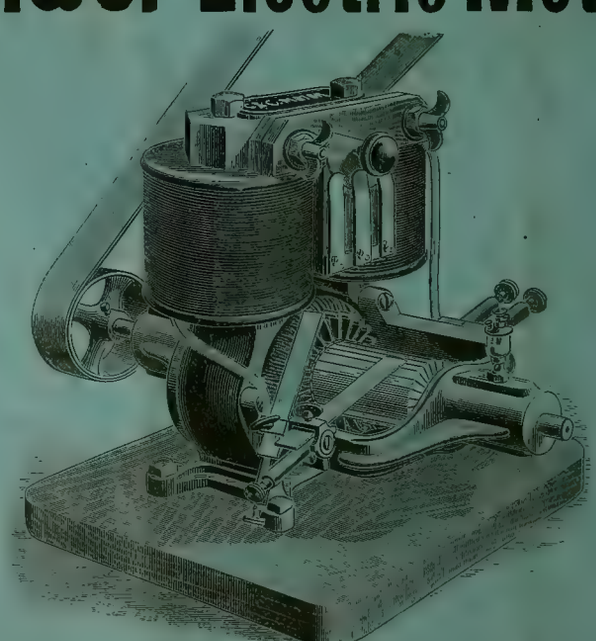

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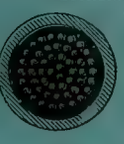

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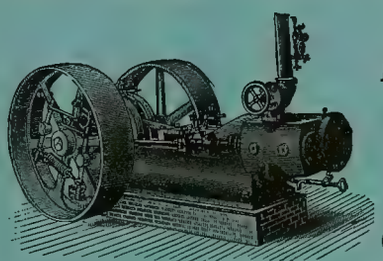

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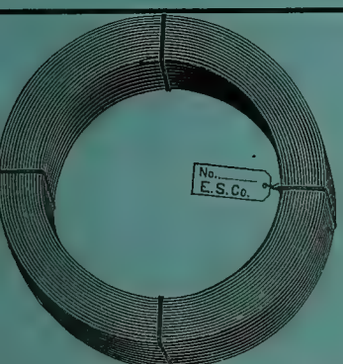

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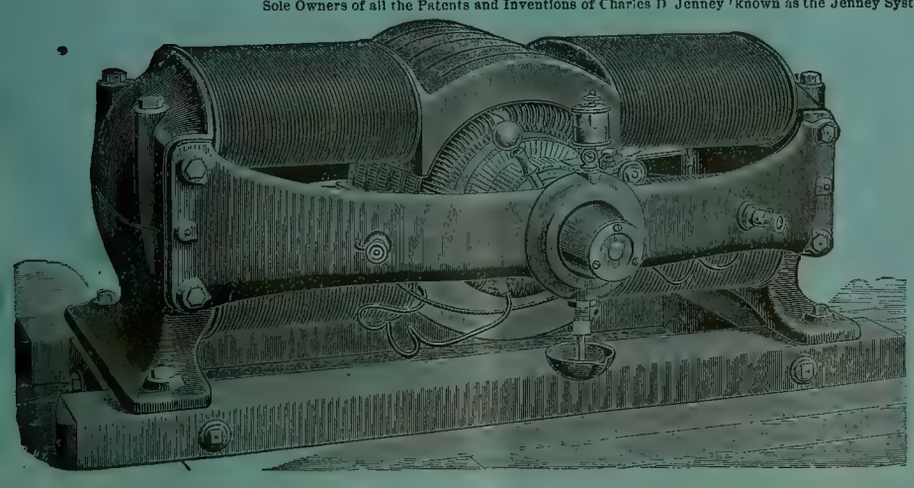

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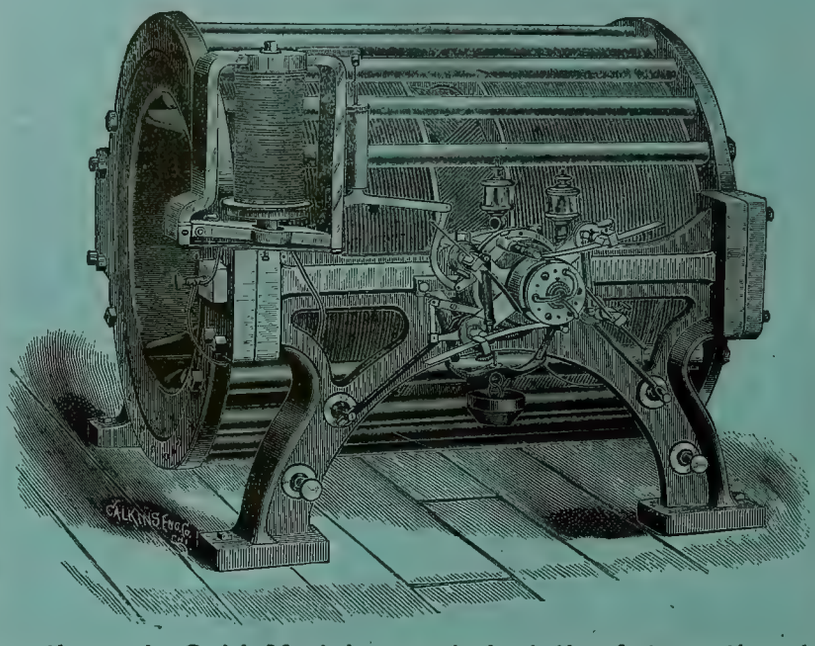

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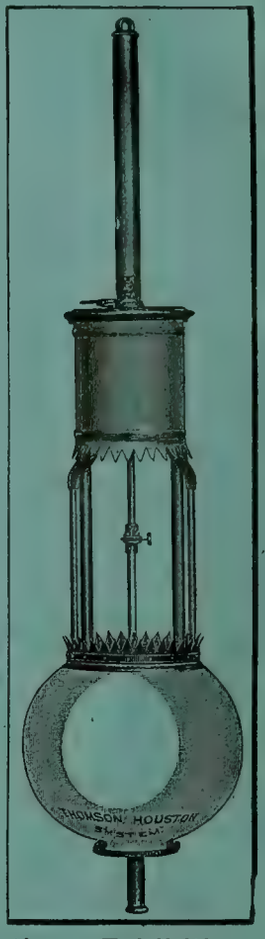
The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

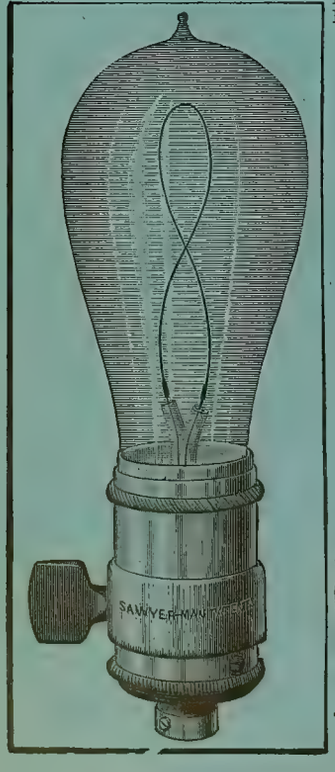


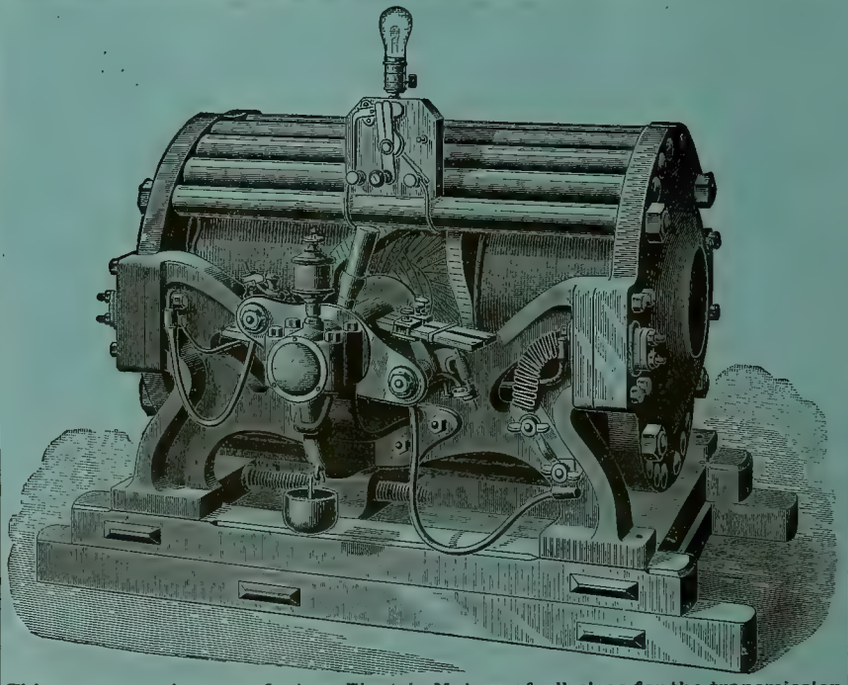
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

MINNEAPOLIS, NOV. 17, 1887.

EDISON UNITED MANUFACTURING CO.,
65 Fifth Avenue, N. Y.

GENTLEMEN:

The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

U. S. OLD LAMP

IN GRAND OPERA HOUSE, MINNEAPOLIS.

WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful Indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of J. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=11$\frac{50}{100}$ per H. P.
EDISON 348 LAMPS REQUIRING 54 H. P.=6$\frac{44}{100}$ per H. P.

COMMENTS ARE UNNECESSARY.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, MANAGER. 216 LA SALLE STREET, CHICAGO.

THE NATIONAL CARBON CO.

CLEVELAND, O.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

The Parker-Russell Mining and Mfg. Co.

Electric Light Carbons

Adapted to all Systems.

CITY OFFICE,
711 Pine St
ST. LOUIS, MO.

M. T. GREENE, *President.* GEO. A. MCKINLOCK, *Treasurer.* WM. H. MCKINLOCK, *Secretary.*

Central Electric Co.

WESTERN AGENTS OKONITE COMPANY.

TRADE MARK

Electric Light, Telephone and Telegraph WIRES AND CABLES for Aerial, Submarine and Underground uses.

38 & 40 La Salle Street, Chicago.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

707 and 709 MARKET STREET, - ST. LOUIS.

BRANCH, 521 DELAWARE ST., KANSAS CITY.

Holmes, Booth & Haydens,

25 PARK PLACE, NEW YORK.

MANUFACTURERS OF

Bare and Insulated Wire,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Lead Covered Copper Wire, for inside use. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire, Patented Barbed Copper Lighting Protector Wire.

SOLE AGENTS FOR

The Forest City Carbon Mnfg. Co., Cleveland, Ohio.

Western Agency, 185 & 187 Dearborn St., Chicago.

EDISON'S OPINION.

Geneva Non-Magnetic Watch Company:

Gentlemen:—During the past six months I have submitted the watches containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring to test in different fields of magnetism. I find them exempt from magnetic influence, however strong, and practically no retardation of the balance, nor change in rate occurs, even when in actual contact with Dynamos or powerful Electro-Magnets.

I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

For Full Information about the Watches referred to in the above Testimonial, address:

Geneva Non-Magnetic Watch Co.

(LIMITED.)

177 & 179 Broadway, New York.

Gutta Percha Insulation.

Our Balata Insulated Flexible Cords

ARE SUPERIOR TO ALL OTHERS.

SEND FOR SAMPLES.

GEORGE P. BARTON,

Law Office

Rooms 68 and 69 TEMPLE COURT,

225 DEARBORN STREET, CHICAGO.

Patent and Trade-mark Cases.

Sawyer-Man Electric Co.

LICENSED BY AND SUCCEEDING TO THE COMMERCIAL BUSINESS OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

SAWYER-MAN ELECTRIC COMP'Y. TRADE MARK SYSTEM.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

STANDARD ELECTRICAL WORKS,

MANUFACTURERS OF

HOTEL AND HOUSE ANNUNCIATORS. **Telegraph and Telephone Apparatus,** BURGLAR ALARMS.

SOLE MANUFACTURERS OF THE

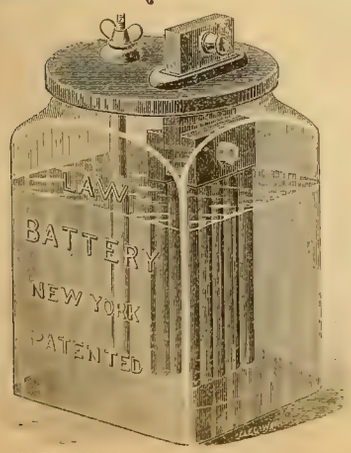
HESS SYSTEM OF GUEST CALL, FIRE ALARM & ANNUNCIATOR COMBINED.

CALL BELLS "POST'S" MAGNETO BELLS, PINS AND BRACKETS, BATTERIES, ETC. ETC.

In Stock: Full Line of Iron, Steel and Hard-Drawn Copper Wire, Delivered at Lowest Prices.

☞ ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES. ☜ **CINCINNATI, OHIO, U. S. A.**

THE IMPROVED "LAW PRISM" BATTERY



SIZE OVER ALL, 4¼ x 4¼ x 7½.

THE NEATEST OF ALL BATTERIES. THE BEST AND CHEAPEST.

With the exception of glass broken by carelessness, and the zinc and sal-ammoniac consumed in the production of current, **all parts of this Battery are Guaranteed** to be **Everlasting.** Perfectly **uniform** and **reliable** in action, of **faultless construction** and **beautiful appearance.**

PERPETUAL NEGATIVE ELEMENTS!!!

These consisting of specially prepared prisms of Carbon are fine depolarizers, performing this function indefinitely, **do not require renewal**, as is the case where chemical depolarizers are employed, thus a **great economy** is effected. These cells are so constructed as to prevent evaporation of the solution, and crawling out of the salts. Thousands of these cells now employed for **Telephone Transmitters, Gas Lighting, Annunciators, Burglar Alarms** and other **Automatic Devices** are giving **Perfect Satisfaction.**

The many Physicians now using the "**Improved Law**" as an office battery, are unanimous in their expressions as to its perfection and adaptability for electrolysis and general galvanization, requiring no renewal nor attention in from two to five years, the latter depending only on the amount of use.

Note:—This battery is not suitable for Galvano Cautery nor Incandescent Light purposes.

LAW TELEPHONE CO., Sole Manufacturers, 112 LIBERTY ST. NEW YORK.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. ANTWERP. LONDON.

MANUFACTURERS OF AND DEALERS IN

ELECTRICAL APPARATUS AND SUPPLIES

INCLUDING

Electric Lighting Apparatus, Insulated Wire and Cordage,

PATTERSON CABLES,

Electric Bells, Annunciators and Push Buttons, Electrical Testing Apparatus, Watchmen's Clocks, Field and Firman 11 Call District Box with Answer Back Signal,

DISTRICT TELEGRAPH BELLS, RELAYS AND REGISTERS,

Magneto Bells and Switch Boards, Police and Fire Alarm Boxes, Registers, etc., Telegraph Instruments, Batteries, Linemen's and Inspectors' Tools.

Washburn & Moen Mfg. Co.'s Line Wires. Crossarms, Pins, Brackets, Insulators, Carbons, Arc Light Globes, Etc., Etc.

WESTERN ELECTRIC COMPANY'S

Electric Lighting Apparatus

OUR SYSTEM OF ELECTRIC LIGHTING IS COMPLETE IN EVERY DETAIL, AND IS UNEXCELLED IN THE EFFICIENCY AND WORKMANSHIP OF THE APPARATUS, IN THE BRILLIANCY, STEADINESS AND COLOR OF THE LIGHT PRODUCED, AND IN AUTOMATIC REGULATION.

WE HAVE STILL A LARGE QUANTITY OF

KERITE WIRE,

Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even No. 16 gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes Nos. 13, 14, 15 and 16.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, JANUARY 14, 1888. No. 2.

Fein's Dynamo.

It is a somewhat remarkable fact that at the present time, when owing to the expiration of the English patent for drum armatures, some firms in this country have abandoned the Gramme type of winding, and are now adopting the type originally introduced by Herr Heffner von Alteneck, says *Industries*, prefacing a description of the Fein dynamo, illustrations of which are given in connection. Messrs. Siemens, of Berlin, are in certain cases pursuing exactly the opposite course, that is to say, whereas formerly they only made machines with drum armatures, they are now largely manufacturing machines with cylinder armatures wound on the Gramme principle, in combination with internal field magnets. The priority of invention for this type of machine is claimed by various German makers, and has even led to patent litigation. At first sight it would certainly seem that a machine with internal poles is not an improvement over the usual type, but rather the reverse. The armature must be overhung, which introduces mechanical difficulties of construction considerably greater than in a machine of the ordinary type. An external armature must also be more liable to accidental injury than one which is surrounded by field magnets, whilst the difficulty of securely holding those parts of the armature

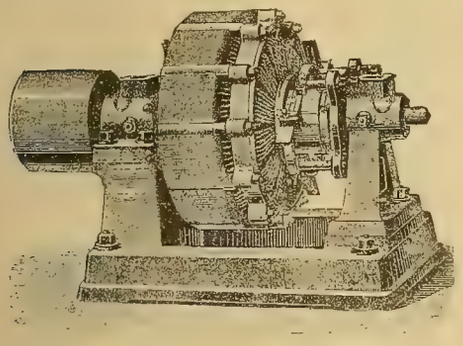


FIG. 1.—FEIN'S DYNAMO.

winding which do the work must be very much greater. In the ordinary type of machine the armature wires are either held between projections or are pressed against the surface of the core by binding hoops; but in the type with internal poles binding hoops can obviously not be applied, and as far as we know projecting driving teeth have up to the present not been used. That these difficulties can, however, be successfully overcome is clearly proved by the fact that at least four firms in Germany have now adopted this type of machine, viz, Messrs. Siemens, Messrs. Ganz & Co., the Helios company, and Mr. Fein, and the type seems, therefore, one well worth the consideration of our own electricians.

The machine illustrated in Fig. 1 is intended for an output of 15,000 watts when driven at 520 revolutions per minute, and its total weight is only 1,624 pounds. The weight of copper on the armature is 39 pounds; that on the four magnet cores, which are arranged as shown in the sketch Fig. 2, is 158 pounds. The resistance of the armature is .052 ohm. The machine is compound wound, and the resistance of the main circuit, that is, of the four main exciting coils coupled in parallel, is .023 ohm; that of the shunt circuit, 28 ohms. The current is 136 amperes, and the terminal pressure 110 volts. The inner diameter of the armature when wound is 19⅝ inches, the external diameter is 25 inches, and the length 6½ inches. The core consists of two hundred soft iron disks, insulated with paper, and mounted on and supported by twelve insulated bolts. This cord is wound with one layer of square wire in 576 turns, connected Gramme fashion with a large commutator containing ninety-six parts. The field magnet cores are square, with rounded corners, each being wound with seventy-two turns of main wire and eleven hundred turns of shunt wire. From these figures it follows that at full output the main exciting power is 4,900 ampere turns, and the shunt exciting power 8,900 ampere turns, or a total of 13,800 ampere turns.

Chicago Electric Club.

The inauguration of the club rooms of the Chicago Electric club at 122–124 Clark street was observed Saturday evening, January 7th, in an informal but nevertheless exceedingly enjoyable manner. The whole matter was left entirely to the entertainment committee, consisting of H. Ward Leonard, chairman, J. L. Barclay, A. H. Brown, C. C. Haskins and Chas. D. Shain, and well they carried out the trust imposed upon them. The committee in response to queries in advance to the event replied in an off-hand manner in each case that the inauguration would be observed in a very informal way. "A little music, a little lunch; that's all," and President Stiles impressed the same fact upon his hearers when he rapped for order shortly after eight o'clock. His remarks too were informal and were in effect that the members of the club had gathered not for business nor to "talk shop," but for pleasure and social enjoyment. He inferred from the programme that the music would be enjoyable and from the appearance of certain tables, heaped high with viands embracing seasonable delicacies and potables, that there would be no difficulty in passing the evening in a pleasant manner. The president then resigned the guidance of the evening's enjoyment to Chairman Leonard of the entertainment committee. The appended programme subject to a break to permit an attack upon the lunch was then presented:

Solo for Zither Violone—Guitar Accompaniment,
"Grand Concert Fantasia." *Lahodny*
Prof. F. Lahodny and James D. Millan.

Duet for Banjo and Guitar— - - -
(*a*) "Pretty as a picture."—Potpourri. ——
(*b*) "Kismet" Grand March. *Baxter*
Prof. Wm. S. Baxter and James D. Millan.

Bass Solo—Drinking Song—"Down deep within the cellar." - - - - - ——
Mr. E. C. Cowles.

Solo for Zither Violone—Guitar Accompaniment *Selected*
Prof. F. Lahodny and J. H. Robson.

Guitar Solo—"Song without words" *Mendelssohn*
Prof. Wm. S. Baxter.

Bass Solo—"Old Simon, the Cellarer." - ——
Mr. E. C. Cowles.

Zither Solo— - - - - *Selected*
Prof. F. Lahodny.

Banjo Solo—"Home, Sweet Home," with variations ——
Prof. Wm. S. Baxter.

Bass Solo—"Who deeply drink of wine." ——
Mr. E. C. Cowles.

Duet for Mandolin and Guitar
Potpourri of Popular Melodies
Prof. Wm. S. Baxter and James D. Millan.

While the informality of the evening's entertainment was constantly brought to mind in invitations, in announcements and in the president's opening remarks, it would seem that the committee had created a wrong impression as far as the music was concerned. It is a question whether artists of greater ability in their separate lines could be placed upon a programme of the kind. Professor Lahodny is a master of the zither and brought out in marked contrast the soft, beautiful, sweet, singing effects from the wires at one moment and the grand pealing of a pipe organ the next. His efforts were appreciated to the full and time and again was he recalled.

Professor William S. Baxter on both guitar and banjo showed the eminent skill which has brought him renown not only in America but in Europe, for he has the distinction of having appeared before every crowned head of Europe. Unfortunately his finest effort, a guitar solo, "Song without words," came immediately after the lunch and did not receive the appreciation it otherwise would. The composition credited to Mendelssohn on the programme was nevertheless one of Mr. Baxter's own. Yet it was of exquisite conception and received a rendition equal to its conception. It might be said to be the most enjoyable number of the programme. On the banjo Professor Baxter's ability was fully demonstrated and was ably supplemented by Mr. Millan's guitar accompaniment.

Mr. Cowles provided the vocal part of the programme. In Chicago he is known as a basso of prominence and particularly as the second bass

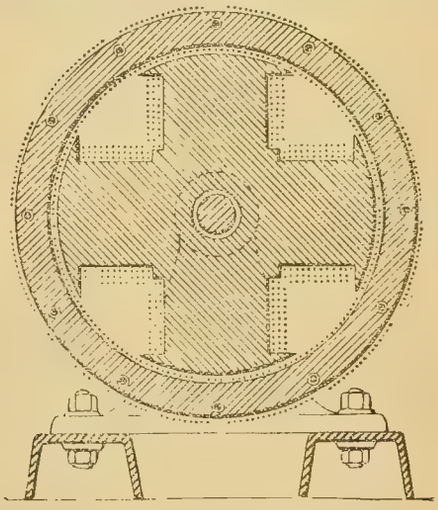


FIG. 2.—FEIN'S DYNAMO.

of the Lotus quartette. His voice is well trained, rich and powerful, and there is little wonder that after each appearance a reappearance was demanded. In fact, the length of the programme was just doubled by the repeated encores.

In regard to the lunch it might also be said that the committee and president created a wrong impression. At a prearranged break in the musical programme an adjournment was taken and with that rapidity and deftness that characterizes well-trained waiters, the assembly room was transformed into a dining room. The lunch, so-called, was quickly spread and its resistance was put to the test. Suffice it to say that devastation ruled supreme when the members present had performed their part of the evening's entertainment. The musical programme was then resumed and continued until an hour so near that which marked the commencement of the next day that the difference was hardly noticeable.

At the close of the programme on motion of Chas. A. Brown, seconded by C. C. Haskins, a hearty vote of thanks was tendered the entertainment committee and the artists who had assisted them.

President Stiles called for "Ayes—out loud" and received them — no one dissenting.

Brief remarks, quips and stories from Messrs. Haskins, Buckley, Monroe, Annett, Schultz and Pearson followed, interrupted at times by the ringing of an electrical bell controlled by a waggish member who took this method of expressing his private opinion of the superannuation of some of the remarks.

C. F. Annett, of the Rocky Mountain Bell Telephone company and United Electric company, Salt Lake City, Utah, was a welcome guest. The Chicago members of the club present are included in the appended list :

A. K Stiles, Van Depoele Electric Manfg Co.
Chas. A. Brown, Western Electric Co.
John Young, Western Electric Co.
Harold V. Hayes, Excelsior Electric Light Co.
H. W. Leonard, Leonard & Izard.
A. H. Brown, Leonard & Izard.
C. C. Haskins, City Inspector of Electric Lights.
W. B. Pearson, A. L. Ide & Son.
G. C. F. Hall.
Theo. P. Bailey, Thomson-Houston Electric Co.
Wm. J. Buckley, Fort Wayne Jenney Electric Light Co.
W. A. Sheldon,
Frank Stewart, Western Electric Co.
H. P. Pratt, Pratt & Plumb Telephone Co.
John I. Martin, Thomson-Houston Electric Co.
C. K. Giles, Giles, Bro. & Co.
F. W. Horne, Excelsior Electric Light Co.
T. S. Miller, Link-Belt Machinery Co.
W. A. Kreidler. WESTERN ELECTRICIAN.
J. L. Barclay, Holmes, Booth & Haydens.
P. G. Monroe, WESTERN ELECTRICIAN.
E. M. Hawley, Johnson, Holland & Co.
J. Wayland Clark, WESTERN ELECTRICIAN.
W. S. Andrews, Edison Co.
Will. Lenhart, U. S. Electric Lighting Co.
A. M. Searles, U. S. Electric Lighting Co.
C. B. Curtis, Solar Carbon & Manfg. Co.
F. A. Wunder, Wunder & Abbott.
Geo. G. Carter, Electrical Supply Co.
Fred DeLand, Electrical Supply Co.
F. S. Terry, Electrical Supply Co.
C. C. Warren, U. S. Electric Lighting Co.
M. J. Grogan.
W. A. Turner.
E. M. Izard, Leonard & Izard.
E. C. Loveland, Johnson, Holland & Co.
G. A. Harter, Electrical Construction Co.
Elmer A. Sperry, Sperry Electric Light Co.
Wm. Taylor, Electrical Supply Co.
H. Jampolis.
E. B. Brown, Gutta-Percha & Rubber Manfg. Co.
Chas. B. Castle, Gutta-Percha & Rubber Manfg Co.
Wm. Hughes, *Street Railway Gazette*,
Jules A. Schultz, Germania Fire Insurance Co.
J. W. Brennan, Town of Lake Electric Light Co.
J. H. Reid, Mather Electric Co.

The stated meeting of the club will be held next Monday evening.

The McIntosh Company's Loss by Fire.

January 7th, the McIntosh Galvanic & Faradic Battery company and the the Emmert Proprietary company of Chicago were sufferers from a disastrous fire. The companies occupied the first, second, sixth and seventh floors of a seven-story brick building at 300 and 302 Dearborn street. Late in the afternoon a fire broke out on the fifth floor and in a very short time the three upper floors were a furnace of flame. The flames were fought with that determination for which Chicago firemen are noted, but it was impossible to do much more than to save adjoining buildings and those across the street. A little more than half an hour after the fire was discovered the wall from the fourth story upward toppled over into the street. The lower floors were not burned but were literally drowned in water.

The total loss on building and contents will reach nearly $175,000. The building was erected in 1885 at a cost of $70,000, and was insured for $40,000.

The McIntosh and Emmert companies had a good deal of machinery which was used in connection with the business, all of which was placed on the top floor.

Their loss will probably foot up $75,000 on machinery and stock, the McIntosh company being the heaviest loser, the firm estimating the value of its stock and machinery at $50,000. This is fully insured. The Emmert company's policies will also cover the losses.

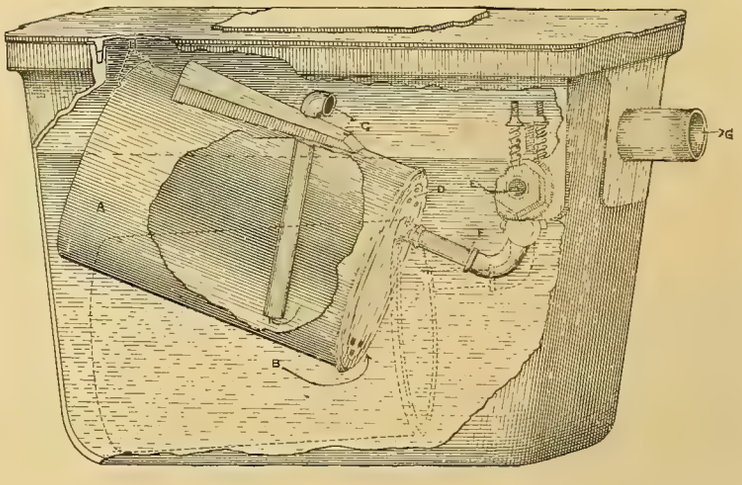
The C. Biele Electric Apparatus company was also a loser by the fire.

The recent storms along the Atlantic coast seriously interrupted the transmission of cablegrams and telegrams.

Philadelphia's Subways.

The *Mechanical News*, of January 1st, publishes a review made by Mr. Walker, chief of the electrical bureau, on the progress that has been made by Philadelphia in burying its wires. "Beginning with the electric light, we have five miles of cable laid on Broad street, running from Fairmont avenue to Tioga street. A portion of this, from Columbia avenue to a point near Lehigh avenue, has been down two years, and we have had but two lights go out on us during that time. On Front street, from South to Vine, there are two and one-half miles of cable laid, the work having been done for the Board of City Trusts by this department. The Trust has control of the highways along the Delaware river front within the limits of the old city proper. We also put down three miles of cable inside of the Girard college grounds for electric lighting purposes. The city now has ten and one-half miles of electric lighting cable which hold but one wire. If the city should decide to do her own electric lighting altogether, we would first move to put them underground, as the heavy electric wires are the most dangerous of any.

"Now we will come to the telegraph and telephone underground wires. I will begin on Broad street, north, where we have two cables, each containing six wires, one 21,120 feet in length, and the other 10,560 feet, which gives us six miles of cable, or 380,160 feet of wire, or seventy-two miles. On Fifth street we have two cables of six wires each, which extend about 1,000 feet, which gives us 12,000 feet of wire.



Then, at the City hall, we have five cables 3,000 feet in length, containing, in all, seventy wires, which gives us 210,000 more feet of wire. Again, we have one and three-quarter miles of cable, or 9,280 feet, with three wires each on hand ready to be laid, which gives us 27,840 additional feet of wire.

"Now that much the city has done, and there has been expended this year $18,000 in placing the wires underground. If we add these together we find that the city has, of her own, nineteen miles of cable, and, with the single wire in the electric lighting cables, a total of 686,440 feet of wire, or 130 miles. The American Telephone company—or the long-distance, as it is generally termed—has about twenty-two miles of cable laid in the city limits, between Vine and South streets and the two rivers. Each cable will average twenty wires, and that would give 3,323,200 feet of wire. So that, without taking into consideration the few squares laid by various companies, and ignoring the conduits being laid, there are now forty-one miles of cable in operation, containing 4,009,640 feet or 760 miles of wire. The city receives from the American company the privilege of placing one cable or three wires in each conduit free of all cost. In their conduits we now have three wires on Walnut street, running from river to river, or 12,500 feet, and three on Fifteenth street for a distance of 2,600 feet, and there are three in a cable of 3,000 feet in length in use by the Water Department. So that in all, irrespective of the electric lighting cables, the city has in active telegraphic and telephonic use 70,500 feet of cable, or about thirteen miles."

A War of Talking Machines.

A New York dispatch of the 5th inst. reads: The appearance of two different types of talking machines, the phonograph of Thomas A. Edison, and the graphophone of Bell of Washington, both of which instruments are expected on the market within the next ten days, will probably be the signal for one of the most bitter patent fights upon record. The original patent of Mr. Edison for his first phonograph has yet five years to run. Under it he claims no talking machine of the type of the phonograph can be made without his permission. The graphophone is said to be virtually a copy of the Edison phonograph, with certain mechanical differences. Clock work, or a treadle movement, is used in place of an electric motor to turn the cylinder, otherwise the principles of the two instruments are identical. There is still another talking machine reported from Boston, said to be the invention of a Massachusetts inventor, who virtually goes over the same ground that Edison has worked, and, according to printed reports, intends to put his apparatus before the public regardless of any previous patent or patents. Edison professes the profoundest distrust of the patent office as a protection to inventors, and says that he will confine himself to the search for trade secrets, whose profits he can reap until some one else deserves them.

Improved Steam Trap.

To many an electric light station a steam trap is essential. That shown in the illustration in connection is familiar to most of our readers, but the addition of a very small improvement, will sometimes add much to the efficiency of a device, and increase the demand for the same.

The working of this trap has given much satisfaction to a great many who have had the opportunity to test its capacity, and the large number in use attest its value. The makers have made improvements in the valve which is actuated by the float, that render its action positive, and is furnished with springs that insure a close seal, under all the varying conditions to which steam traps are subjected.

Our readers will readily see the working of this trap by an examination of the illustration.

The sale of this steam trap in the west is in the hands of H. A. Glasier, western manager of the Jarvis Engineering Co. Chicago.

A Wave Motor.

After many accidents and trials, says *The San Francisco Call*, the wave power motor so long talked of has at last been finished and proved a success. The construction of this machine or apparatus, which was begun in July, 1886, was at the time considered a hair-brained scheme, but the projectors stuck to their plan and seem now to be in a fair way of success. Great difficulty was experienced at first in getting the materials to withstand the force of rocks thrown against them by the waves, and the pipes which conduct the water up the bluff were broken and carried away no less than fourteen times. When the schooner Parallel went ashore and her cargo of dynamite exploded the motor was completely wrecked. A mass of rock weighing six hundred tons was thrown from the cliff and fell across the chasm over which the motor was suspended, blocking it up to such an extent that nearly three months were consumed in blasting out the debris. Soon after another mass of stone weighing 150 tons fell and had to be removed. The motor is a very simple contrivance and still is capable of exerting a great power.

Across a chasm in the rocks just north of Parallel point a bridge of heavy timber was built. Suspended from this is a huge fan or paddle of

oak timbers, with the spreading portion downward. This is fastened to the bridge by immense hinges which allow it, when in operation, to swing back and forward a distance of

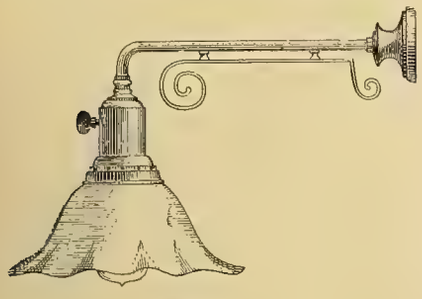


FIG. 1.

thirty-six feet as the waves strike it. The handle or upper portion of the fan is connected with a solid plunger pump twelve inches in diameter and having a stroke of nine to twelve feet. This pump in turn is connected with a suction pipe running out into deep water. The fan is so rigged that it can be drawn up out of reach of the waves when not in use. When a wave comes in the fan is thrown forward and forces the air out of the pump barrel, in which the plunger works. On the wave receding the fan is carried seaward and the plunger drawn out, creating a vacuum and causing a quick rush of water into the suction pipe. The force with which the water is drawn up is sufficient to raise it to an elevation of 350 feet above the tide level.

Should this motor prove as successful as the projectors seem confident it will, several others will be built in the same neighborhood and an immense reservoir built on the hill to contain the water.

This one motor, with its twelve-inch plunger, is capable of raising 12,000 cubic feet of water 350 feet high in every twenty-four hours. The uses to which the water will be put are various. A thirty-six inch pipe will be conducted to the city.

The first work performed will be begun in about ten days, and an eight-inch pipe is now being laid for the purpose.

The last-mentioned pipe is for Adolph Sutro and is to be utilized in sluicing away a large amount of drifting sand from the heights just back of the aquarium. This work is rendered necessary to prevent the sand from washing back on the beach and retarding the work there.

FIG. 3.

The immense fan of the motor generates a large amount of energy which is not used in working the pump, and when everything is in shape, electric dynamos will be erected to utilize this energy for heating purposes and the like.

The Heisler System at Vincennes, Ind.

The cuts in connection are in exemplification of the long distance incandescent lighting system at Vincennes, Ind., of the Heisler Electric Light company of St. Louis. Fig. 1 shows a new style of side wall bracket; Fig. 2, the street fixture used and Fig. 3 a street scene.

H. W. Frund, superintendent of the company at Vincennes, writes in reply to interrogations regarding the system: "Our street circuits are a little over thirteen miles, the longest being about seven miles, and we operate, including commercial circuit, eighteen miles. We use numbers 6 and 7 B. & S. gauge for out door wiring and number 11 inside."

In the same letter Superintendent Frund takes occasion to write in terms of the highest commendation of the system: "In justice to the Heisler system, we must say that it is excellent for street and commercial lighting. We have been in operation now one year and a half and the light has given satisfaction to every one. The machines and the whole system are from a mechanical and electrical standpoint, simply perfection and have never been out of order for an instant on account of electrical machinery. For months prior to putting in the plant here, a select committee visited many electric light plants, and examined into all existing methods of lighting. The Heisler system was finally adopted and think after eighteen months trial the same to be the best incandescent system out. The problem for lighting our city could not have been accomplished by any other method."

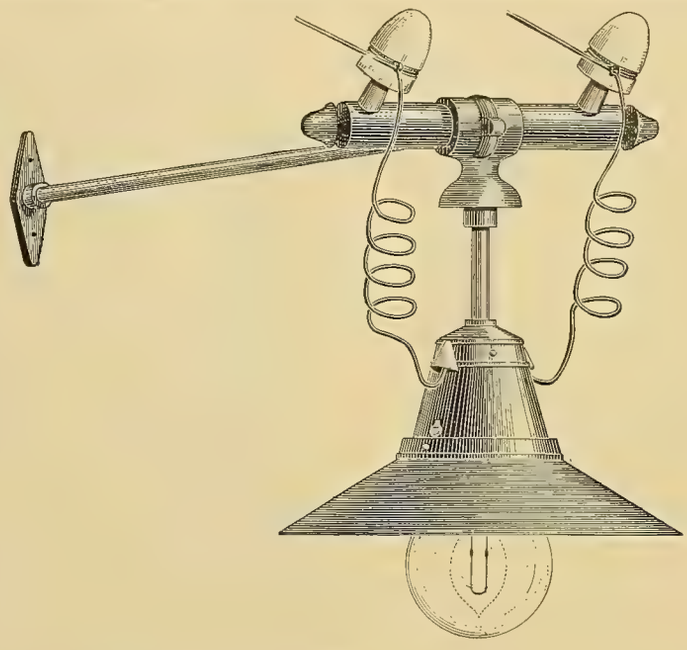


FIG. 2.

Atmospheric Electricity.

Dr. W. W. Anderson in an article on "tornado force" in *Science* Dec. 30th says: "Notwithstanding the intense atmospheric disturbance, which, judging from ordinary thunder-storms, is of just such a character as to produce vast supplies of electricity, the usual electrical manifestations, lightning and thunder, are tame, and out of all proportion to the intensity of the atmospheric disturbance in the tornado as compared with an ordinary thunder-storm. In the tornado there are never, I think, any discharges from the clouds to the earth; objects are never struck by lightning; the thunder, when it occurs, is always high up among the clouds, and rolls away across the sky in long reverberating peals; showing that the static electricity is confined to the upper clouds, and the supply by no means superabundant. What, then, becomes of the electricity of the lower clouds? Does it remain dormant, or does it in some way aid in the destruction?"

Progress of the Messenger Boy.

A man sends me a suggestion for the district telegraph company, says a writer in the San Francisco *Chronicle*. He has evidently been sending a note to a young lady and grown impatient for the return of the boy. It is not a bad suggestion. He wants the company to keep people who send boys out advised of their progress. For instance, they might have blanks ready to fill up and send them to the expectant customer say every fifteen minutes.

"By telegraphic advices from the corner of Kearney and Market the boy is buying a story paper and will at once proceed on his way with your message."

Fifteen minutes later: "Corner Dupont and Geary. Your messenger has reached here safely and is waiting for a car to pass."

Fifteen minutes later: "Union square. Your messenger has already reached the fifteenth chapter of his story. He has only twenty-two more to finish."

"Your messenger has reached Mason and Geary and will proceed as soon as he has smoked his cigarette."

"Your messenger has reached his destination. Will be back to-morrow."

A Bridgeport Conn., letter-carrier, whose duties require him to distribute the mail over his route after dark, has adopted the novel practice of wearing an electric scarf-pin. When desirous of looking at the address of an envelope in the dark, he holds it up before his face and switches on the electricity concealed in his pocket.

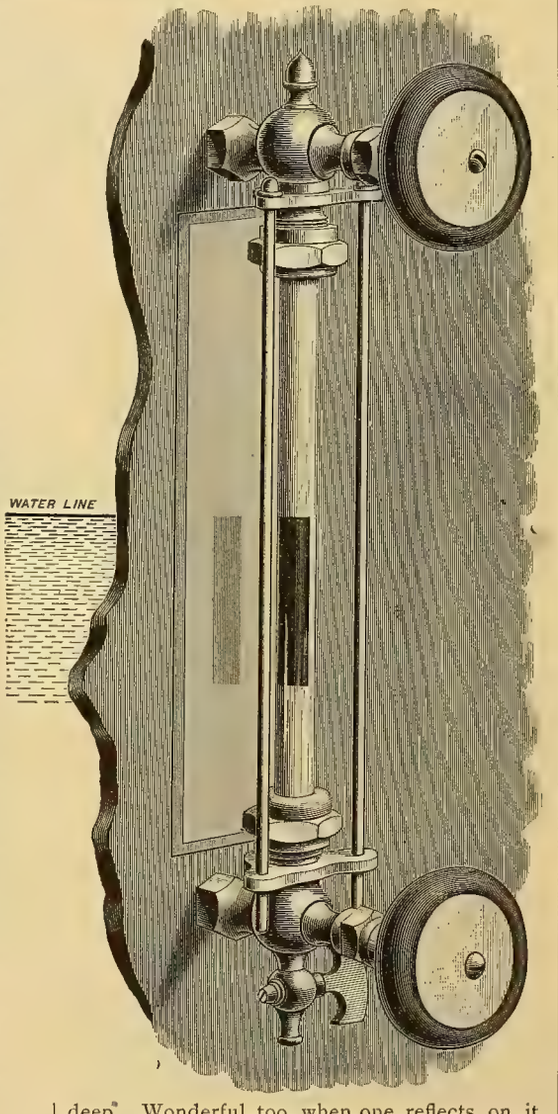
Phelps' Water-Level Indicator and Automatic Gauge Cleaner.

Of great importance to every electric light plant is the steam boiler and its fixtures, and the desirability of an unerring sight gauge is attested by the many attempts to improve the old, time-honored, water column in use everywhere. The illustration which we give explains the merits of Mr. Phelps' invention at a glance. He has solved the easiest, simplest and most practical way possible, by dropping a small float of oxidized silver into the ordinary water column, and placing behind it a white enameled reflector, or background, creating a contrast so forcible as to attract the eye even when not seeking to discover the water level. Its simplicity is one of its greatest merits. Nothing more is necessary than to take out the glass, drop in the float, replace the glass, and fix the reflector behind it. The whole contrivance can be applied in a few minutes, and while the steam plant is in full use. A prominent engineer of the United States Navy when looking at it suddenly exclaimed: "Why, even a blind man can see that. How is it that no one ever thought of that before!"

The inventor conducted his experiments at the large factory of the well-known Weber company, in New York. Mr. Whitehead, an engineer of the first class, who has been Weber's chief for nearly a quarter of a century, says that after using the Phelps float for a season he noticed that its action kept the interior of the glass clean, and entirely did away with necessity of removing the glass for cleaning, so that while showing the water-level it cleans the glass, and therefore saves considerable expense in broken gauges—and every engineer knows that glasses are liable to break after removal, cleaning and replacement. This also gives the engineer more time to attend to his boiler. Mr. Whitehead says it is like an insurance policy which pays its own premium, and afterwards returns dividends in time saved to the engineer, and in cash saved to his employer by that time so saved and by gauges which would otherwise break after being cleaned by hand.

With a view to adoption into the United States navy, Secretary Whitney ordered its consideration by the commandant of the U. S. navy yard at New York, and after five months' investigation the board of examining engineers reported in its favor, recommending it for use in the service. No higher authority could be had in the nation. It bears also the commendation of the police departments of New York and Brooklyn, which have the supervision of the inspection of steam boilers; and many expert engineers, who stand high in their profession, predict for it a world-wide use, as it supplies a long-felt want. Its simplicity and low price will greatly aid its general adoption.

It is being introduced by the Ashcroft Manufacturing company, of 111 Liberty street, New York, who are, in some instances, appointing exclusive agents for its sale.



The Atlantic Cables.

It is just thirty years since material shape was given to Cyrus Field's brilliant dream of wedding the old world with the new by means of electricity. A strand of copper wire 2,500 miles long, was coated twice with gutta percha—a substance the properties of which had been discovered some fourteen years previous by an English surgeon stationed at Singapore. As much iron as would make a cube of twenty feet was drawn into wire long enough to reach from the earth to the moon and coil several times around each planet. This wire was cut into 126 lengths of 2,500 miles, and spun into eighteen strands of seven wires each. When the strand of copper wire had been cased with 240 tons of tarred yarn it was overlaid in spirals with these iron lengths, the whole was passed through a bath of molten pitch, and the first Atlantic cable was complete. It is unnecessary to detail the exciting story of the laying of this "splendid combination of matter"—the failure of 1857, or the success of August, 1858; but it may be worth mentioning that before the cable broke down, the national utility of such a means of communication was illustrated in a striking manner. Two regiments about to return from Canada to England received a countermand directing them to proceed to India to quell the mutiny, but before they sailed news that the danger was passed reached England, and a second countermand was dispatched per cable. The interchange of messages ceased on the 1st of September, 1858, and on the 20th of October, after nearly half a million of money had been spent on it, the cable lay "dead" across the the great submarine plateau of the Atlantic. Over it slowly accumulated the microscopic shells of the multitudinous *globigerniæ* in depths so profound, so cold, so motionless, that the processes of decomposition are arrested, and the sailor in his "heavy shotted hammock shroud" stands erect at the bottom, embalmed, and as perfect in form and feature as on the day he was committed to the deep. Wonderful, too, when one reflects on it, what a vast arc of the rounding blue of the planet is subtended by that length of wire!

The great Atlantic enterprise so absorbs attention that the fact is apt to be overlooked that it was not the first successful attempt to underspan the sea. In August, 1850, the "samphire gatherers," had there been any, might have telegraphed from Shakespeare's Cliff to the fisherfolk at Cape Grisnez; but this, the first submarine cable, lasted for only a single day. It was fished up by a ship as late as 1875. In September another cable was laid, and the London and Paris stock exchanges were able to communicate with each other during business hours. In 1852 Boulogne was connected with Folkestone; in 1853 Donaghadee with Portpatrick and Dover with Ostend; in 1854 Orfordness with The Hague and Corsica with Spezzia; in 1855 the Crimea with Varna—the first telegram announced a brilliant attack on the Russian rifle pits before Sebastopol, and in 1858 England was *en rapport* with Hanover through a cable 280 miles long. The Atlantic cable was, however, the first step—and like most first steps its cost was deterrent—in the tremendous advance of ocean telegraphy. Another trial across the Atlantic was made in 1865, when the Great Eastern was engaged for the work. After about two-thirds of the distance had been run the cable broke, and operations were postponed till the following year, when a complete cable was successfully laid, and that of 1865 was picked up, spliced and finished. Since that date the laying of ocean cables has ceased to be a matter of public interest.

Twenty years ago there was only something like 2,000 miles of submarine cables. In 1883 there were 23 companies, owning 185 cables of an aggregate of 82,214 miles. At the present moment, according to Sir William Thomson, there are 115,000 miles of cable—as much as would wrap 4½ times round the earth at the equator—and the cost of laying them has amounted to something like £38,000,000 or £39,000,000, a sum equal to the entire revenue of the United Kingdom. The mind makes little account of millions, but it may help one to realize the vastness of the sum if it is stated that at the rate of a sovereign a second it would take a year to accumulate £31,000,000.

In a recent survey of "The Foreign news of the Week," lack of space rendered it impossible even to glance at this practical side of the subject—to attempt to consider the means by which we obtain our intelligence from abroad, to suggest the vast spaces traversed, the tremendous bulk of material converted into land wire and ocean cable, the number of persons employed in the incessant traffic in various languages, and the stupendous capital sunk as a foundation for these gigantic enterprises. In endeavoring to deal with some of these topics now, it must be premised that so brief a review as that which can alone be taken here must necessarily be superficial, and that in many cases it is impossible to bring the figures and statistics up to date. It has, moreover, been found impracticable to treat the traffic of the newspapers apart from the work done for the general public. Nevertheless, from the facts and statistics that are accessible sufficient may be compiled to furnish a startling conception of the marvelous manner in which during the past half century the uttermost ends of the earth have been put in almost instantaneous inter-communication. It was on the 25th of July, 1837, —a half century ago,—that the first telegraph, between Euston and Camden Town, was successfully laid and worked. In 1844 the government of Sir R. Peel adopted the new invention for state service. In 1845 the longest line in England, that from London to Southampton, measured ninety miles. In 1846 the first company, the Electric Telegraph company, afterward the Electric and International, was formed. In that year the longest line, that of the Southeastern Railway company, was 132 miles. In 1880–1 there were 26,500 miles of telegraphs in the United Kingdom, 43,900 in France, 44,600 in Germany, 34,200 in Austria, 59,700 in Russia. In Europe the total was 284,100 miles; in America, 168,300; in Australia, 26,900; in Asia, 32,100; in Africa, 12,500. Together with 105,300 miles of cable, the electric systems of the world showed an aggregate of of 629,200 miles. The total outlay on land and sea lines up to December, 1882, was about £88,000,000—about as much gold as could have been drawn into a wire stretching from the earth to the sun. It is noted that at that date Atlantic cables were constructed and laid at an average cost of £550 per mile. Other cables, however, did not exceed £200. Subterranean cables had been laid in Germany at £450 per mile, and ordinary land lines had cost at the rate of £80. No ingenious trifler appears to have calculated the weight of material with which we seem to have burdened the globe, or the mass to which it would bulk were it heaped together. It may, however, be mentioned in passing that the 1853 cable between Dover and Ostend weighed seven tons per mile; that between Folkestone and Boulogne (1859) nine and a half tons, and that in duplexing the two Bennett-Mackey cables, over five acres of tinfoil and twenty-one acres of paper were required in making the inductive resistances and condensers.

Of the marvelous development of telegraphic

apparatus and of the mystery of duplexing wires and cables, it would be useless to attempt to speak here; but it may be briefly stated that whereas in 1837 five wires were required to transmit one message, a single wire can now be used to send simultaneously six messages in any single direction, or one in one direction and five in the opposite, or any other combination of six messages. Equally extraordinary has been the development of speed; in 1844 the rate of transmission was from four to five words a minute; in 1849 a velocity of seventeen words a minute had been obtained; and at the present moment the rate exceeds 460 words per minute by Sir Charles Wheatstone's automatic transmitter, an expert operator being able to overtake only some 30 words by hand telegraphing. In 1847 the queen's speech was telegraphed for the first time —a feat worthy of record—at the rate of 430 letters per hour. Perhaps the most remarkable illustration of the improvements science has effected in this respect is recorded in *The New York Herald* in Jan. 29, 1886:

"One of the leading firms of arbitrage brokers in this city sent a message yesterday morning from the stock exchange office of the Mackay-Bennett Cable company to London. The business referred to in the message was transacted and the answer received in New York in the space of six minutes—the quickest time on record."

A glance at a good telegraph map shows England as the center of a very spider-web of electricity. Persons of other nationalities will probably claim that the remark applies equally in their own countries, and that Great Britain is not the only *retiarius* in the arena of mercantile competition. Taking London, however, as the temporary "hub of the universe," and looking abroad, it will be seen that no fewer than eight cables—six from Ireland and two from England —place us in communication with the western world. Of these, the earliest were laid by the Anglo-American Telegraph company, from Valentia, off the coast of Kerry, to Heart's Content, Newfoundland—one in 1873 and the other in 1874. The length of the first is 1,881 and that of the second 1,840 nautical miles. The next cable was laid by the Direct United States Cable company in 1874-5 from Ballinskelligs bay, south of Valentia, to Torbay, Nova Scotia—length, 2,423 nautical miles. A third cable was laid in 1880 by the Anglo-American company. It also landed at Valentia and Heart's Content, and its length was 2,648 miles. In 1881 and 1882 the Western Union Cable company laid two cables from Sennen Cove, near Penzance, to Dover bay, near Canso, Nova Scotia. The length of the first was 2,531, of the second 2,576 knots. The last two of the eight British cables were laid by the Commercial Cable company from Waterville, on Ballinskelligs bay, to Canso —length, 2,353 knots each. Two other lines of communication require to be classed with these in dealing with North America—the Anglo-American cable 2,648 knots, laid in 1869 from Menou, near Brest, on the French coast, to St. Pierre, and the French Telegraph company's cable, 2,242, laid ten years later, between the same terminal points.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number XXV.

The Electric Lamp. — The production of light and heat by the electric current depends primarily on the strength of the current and on the resistance which it encounters; the development of heat in a conductor, according to Joule, being proportional to its resistance, to the square of the strength of the current, and to the time the current lasts. We have illustrations of this in the spark of the electric machine and in the lightning's flash, both of which result from the resistance of the air to the passage of electricity. Heat is always a result of this resistance, even in the best conductors, and precedes the production of light; but the resistance encountered in such conductors as copper and iron is not sufficient, except with currents of abnormal strength, to raise the molecular intensity to the degree requisite for the production of light. The case is analagous to that of the production of heat by friction, where heat development is in the inverse ratio of heat conductivity; friction between wooden surfaces rapidly produces combustion, the effect being, from want of conductivity, concentrated on the points in contact, while from the conductivity of metals the heat developed by the same amount of friction is distributed through the mass, and the temperature developed at the points of contact proportionally reduced, the proportion depending on the conductivity of the metals. Similarly what takes place on the surface in mechanical friction may be assumed to take place throughout the mass in the molecular action which we term electricity. And if, as we have assumed, electric conductivity depends on molecular arrangement, the internal friction between the molecules must be greater in an abnormal arrangement, such as may be assumed to exist in substances of low conductivity, than in the normal arrangement assumed to exist in those of high conductivity. Hence the choice of a substance having the proper proportions of conductivity and resistance conbined with other necessary qualities becomes an important consideration in the construction of the electric lamp.

The Arc Lamp. — There are two methods of producing the light, one depending on the combustion of the light-producing substance, and the other on its incandescence; and these methods have given rise to two systems known respectively as the arc light and the incandescent systems. The arc light is the oldest, and originated with Sir Humphrey Davy in 1800; and it is

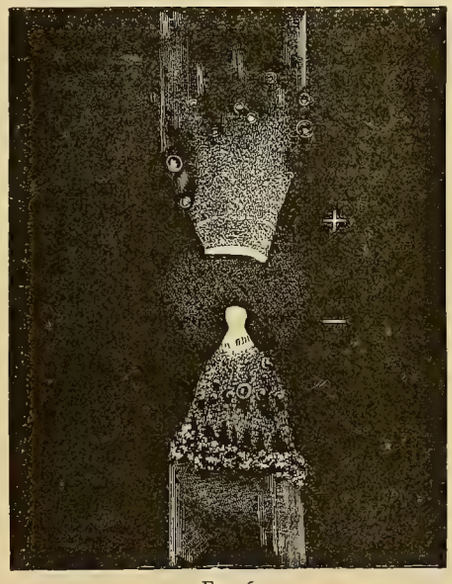


Fig. 62.

remarkable that carbon, the substance in common use in the modern electric lamp, was the substance which he adopted in those early experiments; and the construction of the modern lamp has for its principal basis the same fundamental principles which he discovered and adopted. Passing a current furnished by a battery of 3,000 voltaic cells through two rods of common wood charcoal, placed end to end, he obtained, on slightly separating them, a light of intense brilliancy and heat, having the form of an arch, or arc of a circle; hence the term voltaic arc, designating both the origin and form of the light, the latter term being still retained while the former has fallen into disuse since the battery, as a generator for lighting purposes has been superseded by the dynamo.

The contact of the carbons is necessary for the establishment of the current, and their subsequent separation for the production of the light. The ordinary current which maintains the light is not strong enough to pass through an air space of even $\frac{1}{10\,000}$ of an inch, but the extra current produced by the separation of the carbon after contact is far more powerful, resulting from the difference of potential caused by the sudden accumulation of energy on the positive side of the break, and the negative condition on the opposite side; a film of carbon is volatilized by this powerful current, and the space between the carbons filled with carbon vapor, which is a partial conductor of very high resistance. The combustion of this vapor, and of the carbons themselves by the union of oxygen, heats the air and reduces its resistance, so that the current is maintained in this heated air and vapor at its normal strength through a resistance varying from a half ohm to 100 ohms, and across an air space of $\frac{1}{16}$ inch to $\frac{3}{4}$ inch. The light is of intense brilliancy, varying from 1,000 to 2,000 candle power, being greatest on the surfaces of the carbon points, especially on that of the positive carbon, while the heat, which is also of great intensity, is greatest in the carbon vapor, and capable of volatilizing the most refractory substances, not excepting even the diamond.

The constant current is usually preferred for the arc light, and the vertical position for the carbons, the current passing from the upper to the lower carbon as shown in Fig. 62. The upper or positive carbon is consumed about twice as rapidly as the lower or negative carbon, the lower one becoming pointed while in the upper a crater is formed as shown. The light being the most intense on the upper carbon surface as stated, emanates chiefly from this crater and is radiated downwards; the amount thus radiated being equal to about 65 per cent. of the entire light produced. This is the principal reason why the constant current is preferred for arc lighting; illumination, except in special cases, being wanted below rather than above or in a horizontal direction, especially from arc lights, which, from their intense brilliancy and the powerful currents which they require, must be elevated for safety.

With the alternating current both carbons are consumed at the same rate, and both retain the pointed form which permits a free radiation of the light in nearly every direction. For light-house illumination there is an advantage in this, and by reflectors and lenses the light can be concentrated and intensified in a given direction. While there would seem to be an economical advantage in the equal consumption of the carbons by the alternating current, it has been ascertained by experiment that the carbon wastage is much less with the continuous current.

The globules shown in the cut on the surface of the carbons result from silica which is found in them as usually prepared, and which, becoming fused, collects on the surface and drops on the lower carbon with a hissing sound, producing a momentary reduction of the light.

The flame assumes the form of an arc from the fact that the electric potential of the space between the carbons is much higher than that of its surroundings, including the air and external objects; consequently the incandescent vapor is repelled from this space by virtue of equality of potential within the space, and attracted outward by virtue of difference of potential between the space and its surroundings; and the flame being connected with the carbons above and below, the central part alone yields to this outward pressure, producing the arc.

Since the alignment of the carbons is not exact, nor the surfaces in contact perfectly flat, the flow of the current before separation is liable to be through points at one side of the centre; and after separation and the formation of the crater the line of least resistance is evidently between the point of the lower carbon and the lowest point on the edge of the crater. The highest potential is evidently through the center of the flame where the principal part of the current is flowing, and the outside potential being lower than the potential at any point between the carbons the flame bends out to one side, instead of equally on all sides, and forms an arc; whereas if the current were perfectly central, and the outward pressure perfectly equal on all sides, the flame would be a spheroid.

As each lowest point on the edge of the crater is consumed, and the distance and consequently the resistance is increased, the flame shifts to the next lowest point, and so travels round the edge of the crater while pivoted on the point of the lower carbon.

As an electric current can be attracted or repelled by a magnet, this flame-bearing current exhibits the same effects, and the arc can thus be increased or diminished by the approach of a magnet; and also be attracted by the approach of an unmagnetic body of different electric potential.

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EXPECTANT eyes have been turned toward Washington for the supreme court decision in the Bell telephone case, and yet another Monday has rolled around and the decision has not been handed down.

THE description of the Denver electric light station, given in our correspondence columns this week, is exceedingly interesting and instructive. The *modus operandi* is so clearly explained that there will be no difficulty in comprehending the measures taken to avoid the possibility of a break down. Careful and able expert work can be seen throughout in the construction of the plant.

THE articles on electric measurement by J. Swinburne, which we have reproduced in this and the last issue, will amply repay an attentive perusal, and are the more interesting since they are free from perplexing mathematical detail. The instalment published in our last issue on electric photometry is a valuable addition to the information furnished on the same subject in our issue of December 3rd, in an article written by Professor Badt. It treats entirely of the photometry of incandescent lighting and will be found full of practical information, especially valuable to all who have charge of incandescent light installations. The relations of the several lamps on the same circuit to each other, the breaking of bright lamps on a circuit by attempting to increase the illumination of dull ones, the value of a constant e. m. f. as compared with a variable one, are among the points which receive attention.

The instalment in this issue is on alternating currents and the dynamos and transformers used in connection, in regard to which the writer criticizes the ordinary methods of measurement somewhat severely, and points out the principles on which such measurement should be based.

IN England the attention of the shipping interest is being directed to the importance of having general telegraphic communication with all light-houses, and telephonic communication between the light-house and the shore. It seems that Germany and Denmark have such a system of communication in great perfection, while in England it has been neglected, and life and property have been sacrificed in consequence. The steamer London was wrecked within half a mile of the coast guard station, and within twenty miles of Plymouth, and yet twelve hours elapsed before assistance reached her. And when the Schiller was wrecked on Bishop's rock, scores of lives might have been saved had there been proper means of communication with the shore. This being true in regard to the comparatively limited British coast, it is important to know how the matter stands with reference to our own extended coast on the two oceans, the great lakes and the gulf. Our signal service has done much in averting marine disasters, and our life saving stations in mitigating their severity; but it is of the highest importance that the means of intercommunication between those two branches of the public service and the light-houses off our coast should be made as perfect as possible, both by telegraph and telephone; and as the cost is comparatively light there can be no reasonable excuse for neglect or delay.

In this issue will be found an interesting paper on "Electric energy from carbon without heat," read before the American Institute of Electrical Engineers at New York, Jan. 10th, by Willard E. Case, in which the writer refers to various experiments which he has tried for the direct conversion of carbon into electricity. By our present principal method, we convert carbon into heat, heat into steam, steam into mechanical energy, and mechanical energy into electricity by means of the dynamos. Here are four transformations, each involving a large percentage of waste of energy, and also the pecuniary loss involved in machinery and attendance. By the thermopile we convert the heat obtained from carbon into electricity, thus eliminating the two transformations required by the generation of them and mechanical energy; and the same result is accomplished by Edison's pyromagnetic generator. But the object of Mr. Case's experiments is to evolve a process by which the result can be attained by a single transformation, and he says that "by pursuing this line of investigation we can be sure we are not ignorantly striving against any law of nature when attempting to convert the whole potential energy of carbon into electric energy." Experiment shows that heat and electricity are closely allied, the conductivity of the various kinds of matter being nearly the same for both; and both being in all probability forms of molecular motion by which energy acting through matter manifests itself, it is reasonable to suppose that the matter by which the one mode of motion is generated could, by some of the various processes known to science, be made to generate a kindred mode of motion. This is the whole problem, and the experiments seem to show that its solution may eventually be accomplished, perhaps at no distant day.

THE midwinter meeting of the National Electric Light association is officially announced to be held at the Monongahela house, Pittsburg, Pa., February 21st, 22nd and 23rd, the first session commencing at 11 o'clock a. m., Tuesday, the 21st.

Members of the association desiring rooms are requested to notify S. A. Duncan, chairman of the executive committee, care of the Allegheny County Electric Light company, Pittsburg, Pa.

Western members of the association will be able to secure reduced rates for transportation by addressing George S. Bowen, Elgin, Ill. It is important that notification of intention to attend the convention should be made to Mr. Bowen at the earliest possible moment.

The attendance at the convention should be and undoubtedly will be large. The value of interchange of thought and of the consideration of practical matters connected with electric lighting and kindred subjects is thoroughly appreciated by those who have attended conventions in the past and those who have been present at former conventions will be sure to attend the coming convention. There are others, and they are not few, who are anxious to increase their knowledge of matters pertaining to electric lighting and they should seize this opportunity. But we scarcely need urge the importance or the the value of attendance either upon members who have participated in the deliberations of the association heretofore or those who have an interest in electric lighting either as members of companies or employes.

Pittsburg has been attracting much attention of late by reason of electrical developments and accomplishments by some of its well-known companies, and aside from the beneficial results of attendance upon the convention, there will be the attraction of personal inspection of the city's manufacturing shops and of its notable electric light stations.

THE Chicago *Tribune* last week varied its attacks on the telephone company by indulging in the following bit of humor on the lighting of the river: "The Chicago river is now lighted by electric lights. The utility of this at the present time, from a marine point of view, may be called in question by the sordid man of business, but of its picturesqueness there can be no doubt. Those lights may not now illuminate a stream whose bosom throbs with the mighty commerce of a vast chain of lakes, its waves kissing with ceaseless dalliance the protecting piers that fondly encircle it, and its grateful perfume stealing through the busy highways and gladdening the grateful senses of a grateful people, but they light up a fleet of vessels motionless in the river's icy embrace, yet full of promise for the commerce of another golden summer, and they shine with glittering effulgence on the social, hilarious, and numerous rat that makes its abode in the wharves and moves with cheerful familiarity and insouciance from hole to hole."

This bit of fun will be read appreciatively especially by those who do not care how well the river is lighted but who now pass over bridges and approaches formerly dark and gloomy in the incomparable light of the electric arc, and who are looking forward to the time when the whole system will be in operation. It will also be enjoyed by those interested in a suggestion to the city council last Monday night by Mayor Roche, that "another electric light plant be established in the southwestern portion of the city for the lighting of the Chicago river." He thought the dynamos could be located in the waterworks on Ashland avenue and Fullerton avenue, and the expense would be nominal. About one hundred and twenty-five new lights were needed.

Two weeks ago we referred to the finding of natural gas in Chicago, and now public interest in this matter has received fresh stimulus from another similar discovery made during the present week. This time it has made its appearance in the Leland hotel, corner of Michigan avenue and Jackson street, coming from an artesian well bored over a year ago. The well is 110 feet deep, 100 feet through blue clay and ten feet into Trenton limestone. The water rises to the level of the lake, and there have been indications of gas from the time it was first bored, but not sufficient to attract special attention till within a week, when, on bringing a light near the vent, the gas took fire, and showed the same characteristics in regard to color of flame and absence of odor as the gas recently found at the brewery. As it has to force its way up through about 80 feet of water, the flame is fitful, and has to be relighted repeatedly, but experts say that when the water is shut off, which is now being done, the flow of gas will be astonishing. It is supposed to issue from a fissure in the rock, and to come from a depth of perhaps 1,000 feet, and this receives confirmation from the fact that another well, 50 feet distant, and 114 feet deep, gives no indications of gas; presumably from not having struck the fissure.

It is not generally known that the boring of a well near Western avenue, where the limestone crops out on the surface, has been in progress for some time, and has reached a depth of 650 feet; and it is expected that the gas reservoir will be tapped at a depth of about 1,000 feet. The reason why gas has not been obtained already from some of the numerous artesian wells in different parts of the city, some of which are 2,000 feet deep, is because it was not sought; and when indications appeared they were not recognized, nor means taken to secure the flow, it being necessary to exclude the water in order to admit the gas.

As the cheapest way to obtain light from natural gas is by using it as fuel to produce steam and generate electricity for the electric light, a boom in electric interests in this city may reasonably be anticipated if the hopes awakened by this new discovery are realized. If gas can be had in Chicago for ten cents per 1,000 feet, as in Pittsburgh, or at four cents, as in some other localities, electricity for power as well as light can be generated at a very low figure; and if the supply should continue permanently, our manufacturing interests of every kind will experience an unprecedented development.

Electric Energy from Carbon without Heat.[1]

By Willard E. Case.

The following experiments, undertaken by the author, may be of interest as indicating the way in which the cheap generation of electrical energy may possibly be brought about.

In the first experiment, an element was formed through which heat energy was converted into electrical energy, in which the correlation of forces is beautifully illustrated.

It is a sort of voltaic battery, in which plates of tin and platinum forming the electrodes are immersed in a solution of chromic chloride, which has no action on the plates at ordinary temperature, so no current is generated. The cell is hermetically sealed, and when heated the liquid becomes active, and part of one of its elements, chlorine, leaves the chromic chloride, goes over and temporarily combines with the tin, forming a proto-chloride of tin. The chemical action generates an electric current, but soon the tin is all converted into chloride, and the current ceases. When the cell is cooled, this temporary combination of the chlorine and tin is broken up, and the chlorine returns to the chromium proto-chloride. The tin being set at liberty, falls as a metallic precipitate to the bottom of the cell in the form of beautiful crystals, ready to renew the combination when the cell is again heated. None of the materials of the element are destroyed; they last an indefinite time. The chlorine changes from chromic chloride to tin and back, as often as the cell is heated and cooled.[2]

It is well known that the voltaic battery converts the potential energy of a metal directly into electricity, without heat. This cell, similar to the voltaic battery, converts heat into electricity. The voltaic battery acts at ordinary temperatures, giving up all the energy stored in the metal, and there is the end of it; while this cell acts only when heat is applied to it, converting part of this heat into electricity. After the tin has all been converted into chloride the cell becomes inert, no matter how much more heat is applied. The cell must then be cooled to get the tin back into the metallic state, so here it is necessary to have a difference of temperatures, the tin and liquid being simply a medium by which heat is transformed into electric energy.

It will probably be found that the solution of the tin absorbs heat, and so tends to cool the liquid, and the precipitation develops heat, and so tends to warm the liquid, and that the part where the solution occurs must be kept warmer than that where the tin precipitates. An investigation would probably show that when electric currents are generated, the heat absorbed by the solution of t e tin is in excess of that generated by the precipitation by the equivalent of the electrical energy developed, and that the possible excess is governed by the second law of thermo dynamics. If the cell works between 80° and 180° F., the e. m. f. at the higher temperature is about .26 volt, the efficiency is less than 16 per cent., as the possible efficiency $=\frac{T-t}{T}$ reckoned from absolute zero, or $\frac{638°-538°}{638°}=.157$ per cent. In fact, this cell is a heat engine, analogous to the thermopile, which is said to convert only 2 per cent of the energy of the coal into electric energy. In practice, probably nothing like 16 per cent. could be utilized.

It is an inexorable law of nature, that under the conditions in which we live, a great waste must accompany the transformation of heat into any other form of energy. In the condensing steam engine it requires to condense the steam four or five pounds of water to every pound of steam. Three-fourths the heat used goes to warm that water, and is wasted. In hot air engines or gas engines a cold water jacket must be used, and to it goes the larger share of the heat employed. In the thermopile one set of junctions must be kept cool by circulation of air or water. In Edison's pyromagnetic generator the iron tubes must be cooled by a blast of cold air.

By the second law of thermo-dynamics the minimum amount of heat that goes to this cooling agent, is the fraction $\frac{t}{T}$ of the total amoun employed, where t is the temperature of the cooler reckoned from the absolute zero and T the higher temperature of the working substance; t can not be less than about 500°, so the numerator of the fraction is always large, and the heat wasted is the larger portion. Understand that this is the law of nature: it is inevitable under the conditions in which we live. No cunningly devised furnace, or feed-water heater, or cut-off, or triple extension apparatus, or pyro-generator can save this heat. The most that any of these devices can do is to save what would otherwise be wasted over and above the proportion $\frac{t}{T}$. But are we to go on wasting all this energy of fuel? Can not some means be employed to utilize it? We know that the voltaic battery is not a case of the transformation of heat into electrical energy; it produces electrical energy directly. The second law of thermo-dynamics does not apply, as no heat appears. If we could convert the chemical energy of coal and oxygen into electrical energy, directly and cheaply, we would do away with all our steam motors at once. There is no known reason why a cheap substance may not be found which will act on coal, and develop electric currents in place of heat. This electric energy would be the equivalent of the heat energy, that would be developed by the combustion of the same coal in the ordinary way, and could be transformed into mechanical power, heat, light, etc., with small loss.

So far little progress has been made in this direction. Some time ago, Jablochkoff produced a battery in which plates of carbon and iron were immersed in fused nitre. The carbon being oxidized, furnished strong currents. The objection to this element is the generation of heat through local action. To it the second law does not apply. Another battery of more interest than the first is an illustration of an element which is not affected by the second law, as heat is not essential to its operation, as the energy due to the complete oxidation of carbon is converted into electric energy directly.

In a glass cell containing sulphuric acid, C. P. Sp. Gr. 1.81, temperature 75 Fah., two electrodes were immersed, one of platinum, the other of lump graphite; only a slight e. m. f. was indicated, .007 volt, due to the combination, the graphite acting as a positive element; on the addition of a small quantity of chlorate of potassium to the acid, the e. m. f. immediately rose to .08 volt, the graphite being disintegrated after a time. The cell polarized rapidly, which was partially prevented by mechanical means. The reaction of chlorate of potassium with sulphuric acid may be represented by the following equation: 3 $KClo_3$ (chlorate of potassium) + 2 H_2SO_4 (sulphuric acid) = 2 Clo_2 (peroxide of chlorine) + $KClo_4$ (perchlorate potassium) + 2 $KHSO_4$ (acid sulphate of potassium) + H_2O (water).

A method of exclusion was adopted to ascertain the oxidant of this electrolyte, chlorine peroxide (Clo_2) appeared to be the only active agent. It is decomposed by the carbon, chlorine being evolved with some oxygen. It was assumed that in this cell graphic acid (C_{11} H_4O_5) was formed as the result of the chemical actions. There is probably much waste of energy through local action, as the chemical reactions go on when the circuit is open, but to a less extent. In another experiment an electrolyte was formed of sulphuric acid and chlorine peroxide, the gas being formed in a retort by the action of sulphuric acid on chlorate of potassium, and conducted over into the acid in which it was dissolved.[3] This cell, with a positive element of graphite, opposed to platinum, gave an e. m. f. of .7 volt.

A similar combination was used with a solution of chlorine peroxide in water as the electrolyte. The e. m. f. assigned to these cells is only approximate, as it was found dependent on the quantity of chlorine peroxide in solution, which was constantly changing. The resistance also varied with the different degrees of concentration of the exciting fluid.

Different forms of amorphous carbon were substituted in place of graphite in the first form of cell. Gas carbon gave an e. m. f. of .007 volt when opposed to platinum in sulphuric acid; on the addition of chlorate of potassium the e. m. f. rose to .5 volt.

Carbon, produced by the action of sulphuric acid on cane sugar, in this experiment gave an e. m. f. .3 volt.

The carbon of animal charcoal, wood charcoal, coke and anthracite, gave an e. m. f. variable with each form, ranging from .3 volt to 1.25 volt. The measurements of e. m. f. of the various combinations were made with the electrode immersed in separate parts of the same solution, that the concentration of the liquid and quantity of gas in solution might be as nearly equal in each cell as possible. It was found when the carbon in comminuted form was contained in a porous cup, that the combination gave an e. m. f. of 1.24 volt, apparently due to the presence of the oxygen of the air.

It is impossible at the present stage of the investigation to assign any definite value of the e. m. f. to these forms of amorphous carbon. In some cases they appear to have an e. m. f. higher than that of graphite.

The energy of the combination of carbon and oxygen when completely oxidized to (CO_2) carbonic acid gas is stated to be 9,624. foot-pounds per grain equivalent, which is 2.0594 equivolts.[4] In these carbon elements the e. m. f. is not so high, as there must be deducted the counter e. m. f. or polarization, and the energy due to the force of setting chlorine free.

A resort to chemical analyses, of the product formed by the reaction in the cell, indicates the following conclusions:

First.—Carbons produced by the action of sulphuric acid on cane sugar proved to be partially oxidized, or impure carbon.

Analyses gave the following numbers:

C	62.20 per cent
H	1.61 per cent.
O	36.19 per cent.

Analyses prove that (H_2SO_4+$KClO_3$) sulphuric acid + chlorate of potassium oxidizes carbonaceous bodies, like the above product of (H_2SO_4) sulphuric acid on cane sugar, to CO_2: and further, that such bodies first are changed to compounds soluble in the acid (caramel like substances), which are rapidly oxidized to CO_2.

Second.—Battery carbon of the composition

C	96.20 per cent.
H_2O	.70 per cent.
Iron, SO_2	2.30 per cent.

The fact was shown that this form of carbon can be oxidized to CO_2

Third.—Wood charcoal, of the following composition after ignition:

C	94. per cent.
H_2O	5.5 per cent.
Siliceous res.	.5 per cent.

This, after repeated reignition, was oxidized by the electrolyte to CO_2, no intermediate compounds being formed, and further, in case of pure amorphous carbon the oxidation is complete; that is, that all the carbon is oxidized to CO_2.

These analyses were made with the solution at a temperature 122 F. to hasten the action, the carbon being in contact with the platinum. In these elements the oxidizing material is too expensive for practical use.

Undoubtedly the direction of experiments in the future will be to find some substance which will absorb oxygen from the air and give it up to the carbon; in fact, acting as a carrier of oxygen, so oxidizing it without heat; and this is not improbable, as we already know of substances which do this, though giving a low e. m. f., as, for instance, the ferric salts are reduced to ferrous by agitating their solutions with carbon, being regenerated by absorbing oxygen from the air.

By pursuing this line of investigation, we can be sure we are not ignorantly striving against any law of nature when attempting to convert the whole potential energy of carbon into electrical energy.

1 Read before the American Institute of Electrical Engineers, Jan. 10, 1888.

2 This cell has been described in *Proc. Roy. Soc.*, No. 244, 1886.

3 Great care must be taken in the preparation of this gas, as it explodes at a temperature of about 140 F. It can be preserved in the dark, and is decomposed by sunlight into its component parts.

4 See Sprague's *Electricity*, p. 519.

Practical Electrical Measurement.[1]

By J. Swinburne.

On coming to the question of measurement of alternating currents, one feels inclined to copy Charles Lamb, and begin this chapter by saying "You cannot measure alternating currents."

Before going farther, a digression may be made upon the way alternating currents are generally discussed. It is usual to assume that the curve of electromotive force of an alternating current machine, is a curve of sines, or simple harmonic curve. This is quite unwarrantable. The curve of electromotive force of an alternating current machine may be almost any periodic curve which, when plotted out in the usual way, with the time along the axis of x and the electromotive force along y, will have no part of it at right angles to x. In 1881, Professor Joubert made some elaborate tests of a Siemens alternating current machine, and found the curve to be approximately a curve of sines. On the strength of this, it has been loosely assumed that all alternating current machines give curves of sines. To those who prefer simplicity of mathematical treatment to truth, such a temptation is very strong. In dealing with coils or circuits which have coefficients of induction which are constants, as, for instance, a Siemens voltmeter, the back electromotive force at any instant varies as the rate of increase of the current. Now the rate of increase of the sine of an angle compared with the angle, is equal to the cosine of the angle, and the rate of decrease of the cosine of an angle, as the angle increases, is equal to the sine of the angle. In addition to this, it must be remembered that the sine of an angle is numerically equal to the cosine of that angle, plus a right angle. It is thus easily seen, that those who prefer to make the data fit their mathematics, are sorely tempted to treat an alternating current as a curve of sines, and to deal with coefficients of self and mutual induction, where such things cannot well be said to exist. This tendency to assume simple laws so that they admit of mathematical treatment does double harm, because the assumed laws are more or less wrong, and because electricians have a curious respect for mathematics, so that writers who introduce formidable looking expressions are always supposed to be authorities, and empirical laws are accepted and the real laws are not investigated. As an example, one may mention the laws of friction and speed, a question of great importance in shafting; and the laws of the relation of horse-power to speed in steamers. Coming nearer home, we have various assumed laws as to the relation of the light to the power of incandescent lamps, and of the life and the efficiency. Perhaps the best instance is in dynamo construction. Probably nothing has done so much to disseminate ignorance about dynamo machines as the various empirical formulæ which have mostly come to us through German periodicals.

On objecting to the curve of sines assumption, the writer has been told that even if the dynamo did not give a curve of sines of its own accord, there were properties in a system of converters which compelled it to do so, something in the nature of harmonic fly-wheels. The writer has never come across these. He has also had it pointed out that any periodic function can be represented by a series of simple harmonic functions by Fourier's theorem. That sounds impressive and convincing, but it does not amount to anything. Unless the curve is known the coefficients of the separate terms cannot be found, and if they could, the terms could not be dealt with separately when dealing with circuits with iron cores.

As already mentioned, different types of machine give different no load curves. A Westinghouse machine gives a saw tooth curve with the points somewhat rounded over. A machine patented by the writer last year gives a saw tooth with the points still sharper. In machines with a large air space, the rounding over is generally greater, so that the curve somewhat resembles the curve of sines.

In dealing with the full load curves, it has sometimes been assumed that the armature electromotive force remains the same, and that the terminal electromotive force can be obtained when the armature resistance and coefficient of self-induction are known. With regard to direct current machines, the expression "self-induction of the armature" has already been objected to as meaningless; in alternating current machines the term might be used, but as a rule there is no constant coefficient of self-induction. The assumption that an alternating current armature has a constant coefficient of self-induction is, of course, convenient for use with the assumed curve of sines. Professor Joubert treated the armature of the machine he tested as having a coefficient of self induction. It may have been that he could not resist the temptation, or it may be that in a Siemens machine of the old type the wires of the armature coils are, comparatively speaking, so far from the iron of the field-magnets that the armature actually behaves as if it were in air, and had a coefficient of self-induction. In discussing alternating currents, however, we must not consider old types of machines. Good as was the Siemens as originally brought out, modern knowledge does not design machines like it. Most machines have iron armature cores now. In some, such as the Westinghouse or Ferranti, there is always an air space, in others the armature cores almost touch the poles in passing.

A glance at what goes on will show how complicated the action of an alternating current machine is. At one position the armature cursent tends to increase the total induction through the field-magnets, at another to lessen it. In the intermediate position it is in many cases possible to describe a circuit round the active part of the wire, a small part of this being across two small air spaces, and the rest being in unsaturated soft iron. This opposes any change of the current. In addition to these, any alteration to the magnetization of the field is again opposed by Foucault currents. It is incorrect to call all this self-induction, and treat it as if it had a constant coefficient. The curve of the machine also depends on what is going on in the external circuit. If the dynamo is feeding 100 transformers, each at half load with the iron not saturated, the curve will not be the same as when it feeds 50 fully loaded transformers, with cores highly saturated at each extreme.

It is questionable whether such terms as self-induction and mutual induction are properly used when there are iron cores, and therefore no constant co-efficients. Unless the induction is split up into magnetizing force and magnetization one can not well think of self and mutual induction, and it is simpler to neglect the magnetizing force and consider the magnetization increased to make up for it. Instead of varying coefficients of self and mutual induction, it is much easier to think of varying electromotive forces produced in the circuits. The back electromotive force at any instant can then be called the instantaneous back electromotive force. To talk of the self and mutual induction of the coils of a transformer when there is a closed iron core is very roundabout. Self-induction and mutual induction are also apt to be confused with magnetic induction, especially as they are so often discussed together. The first thing to consider is what we want to measure. People talk loosely of an alternating electromotive force or current of so many volts or amperes, and sometimes mean one thing, and sometimes another, and sometimes nothing. Let us suppose the nature of alternating currents not understood, and imagine an electrician investigating their properties with a view to a system which would admit of his obtaining the information necessary for working an installation by suitable measuring instruments. This method of dealing with the subject was, by-the-way, alluded to by Professor Ayrton in a discussion at the Physical society. The first thing the electrician will want to measure is the power. In an ordinary wattmeter the force acting on the moving coil at any instant, or what may be called the instantaneous force, varies as the product of the instantaneous electromotive force and the instantaneous current. So that if the moving coil has too much inertia to vibrate with the varying force, the mean force varies as the mean product of the electromotive force and current. A wattmeter, assuming there is no self or mutual induction, therefore measures the power. If the part of the circuit in which the power is measured consists of a resistance which gives no back electromotive force, the current always varies with the electromotive force; but if a back electromotive force existed the current would not vary with the electromotive force, but the wattmeter would at any instant measure the product, and would therefore still read the real power.

Having measured the power, the electrician would attempt to split it into two factors corresponding to electromotive force and current in direct current work. He would first try to measure the mean electromotive force and the mean current, but not only would he find that no known instrument will measure it, but that the measurements would be useless if taken. For instance, to make the case simple, suppose an electromotive force were alternately 2 volts and 4 volts for a second each. The mean electromotive force would be 3 volts. If there were 1 ohm in circuit the current would be alternately 2 amperes and 4 amperes for equal times. When there were 2 amperes and 2 volts the power would be 4 watts, when there were 4 volts and 4 amperes there would be 16 watts. The mean power would therefore be $(16 + 4) \div 2 = 10$ watts, but the mean electromotive force and current would be 3 volts and 3 amperes, their product being 9. As the electrician wants factors of the mean power, the mean electromotive force and current are of no use whatever. If there were a varying back electromotive force, the product of the mean electromotive force and current would be still wider of the mark. As the power varies as the square of the electromotive force and as the square of the current when there is only resistance in circuit, the electrician would turn towards the dynamometer, wound as a voltmeter or ammeter, in which the instantaneous force varies as the square of the instantaneous electromotive force or current, and the mean force varies as the square of the mean electromotive force or current. Such instruments, if graduated to read the force, not the square root of it, would read the power. Thus, if the high resistance dynamometer were in shunt to the resistance it would read the power, and the low-resistance dynamometer in series with the resistance would also read the power. In one case the reading, in volts squared, would have to be divided by the resistance, and in the other multiplied by it, to give the power. Still the readings are not what are wanted, as power varies as the square of electromotive force or of current. If the instruments are now graduated to read the square root of the mean force the factors desired are obtained. Thus, to find the power spent in overcoming a resistance, the square root of the mean square of the electromotive force is multiplied by the square root of the mean square of the current, and the result is obtained in watts. These factors may be called the virtual electromotive force and virtual current, as the other expression is cumbrous. The name is fitting, because the virtual electromotive force and current are not the real mean electromotive force and current, but they are such that when working on resistance the power, $W = \frac{E^2}{R} = C^2 R$, E and C being the virtual electromotive force and virtual current. Thus, in the case taken above of 2 and 4 volts on 1 ohm, the voltmeter measures the mean of the two forces, 4 and 16 corresponding to the squares of the instantaneous electromotive forces. This mean is 10, and the dial is graduated to read the root of it. The ammeter similarly reads the root of 10, so that the product is 10, the real power in watts. The power could also have been determined by either instrument alone as the resistance was known.

If, however, there is a varying electromotive force in the circuit as well as a resistance, the product of the virtual electromotive force and virtual current no longer gives the power. For instance, there might be 4 virtual volts when, on account of the back electromotive force, there was no current; and there might be 4 virtual amperes later on with no virtual volts, caused by a forward electromotive force. The real power would then be zero, but the product of the virtual electromotive force and current would be 8. It is almost needless to remark that with a constant current the virtual and real current or electromotive force are the same.

The electrician has now got something to go

1 London *Electrical Review*, December 16th.

upon. In an installation he wants first to know the power given out by his machine. He can get that with a wattmeter. Next he wants to know how that is made up, because a given power might be overrunning a few lamps or running a number dull and heating the leads. As already explained, the product of the virtual electromotive force and current does not always give the real power in watts. If transformers are used the error depends very much on their construction. If the current varied with the electromotive force, the curves of the current and electromotive force would be similar, and might be plotted out to coincide exactly. This is what happens on resistance. The curves might be exactly similar, but the rise and fall of the current might take place after that of the electromotive force. The curves though similar would then differ in phase, and the product of the virtual electromotive force and current would not give the power. Further, the current curve may be of different form, either retarded or not retarded, when the product of the virtual electromotive force and current will again differ from the real power.

The error due to the difference of form and of phase depends very much on the transformers used and on the dynamo. Thus, in every parallel distribution, closed iron circuit transformers cause a very small error compared with open transformers. For instance, imagine a closed circuit transformer with iron so soft that its permeability is infinite, with no persistent magnetism, with wire of no resistance, and with the same number of turns in the primary and secondary. The transformer would then modify the curves in no way, and it would make no difference if it were cut out and the machine coupled direct to the external circuit. If the secondary had more turns its electromotive force would be increased and its current diminished in proportion. Suppose now that the wire has resistance, the effect is then just the same as if the dynamo worked direct on the external circuit with this resistance inserted. The electromotive force and current curves are still similar and the same in phase. Suppose now the iron is not infinitely soft, the current curve will be modified in an irregular way, and persistent magnetism and Foucault currents in the core will also modify both the electromotive force and current curves, so that they are no longer similar nor of the same phase. The difference between the product of the virtual readings and the real power may not be great, but its amount depends on the construction of the transformers, and it is beyond the scope of these articles to go into the question of alternating currents generally.

Protection for Horses Against Fire.

It is to be hoped that before long some simple and practical way will be arrived at of preventing, or at least lessening, the terrible loss of life among the horses, which has hitherto attended nearly every stable fire of importance. A device intended, in case of fire, not only to release simultaneously all the animals, but to turn them out of the building, has recently been put on trial in a New York stable, and seems simple enough. In the principal alleyway leading into the stable is placed a wheel about three feet in diameter, which is connected by shafts with the stalls. A heavy weight is suspended from the circumference of the wheel. Delicate thermostats placed about the ceiling of the stable are arranged so that a very slight increase of temperature will, by expansion, complete an electrical circuit which will loosen the weight suspended from the wheel, and thus set the machinery in motion. A bell will ring, the bolts of the stall will be drawn, the halters of the horses loosened, and lastly, a double stream of water will be thrown into the face of each horse from two jets placed over the head of the stall. The effect of this shower bath will be to cause the horse to back out of his stall. He will find himself free, the doors of the stall and the stable open, and, in his fright at the fire and the unusual commotion, will naturally secure his own safety—at least that is the inventor's programme, though whether it will be carried out in practice remains to be seen. Besides, this doesn't dispose of the question of how to save the poor beasts stabled on the second floor, and until that problem is solved we may look at any time for a repetition of the shocking scenes which attended the burning of the Belt Line stables in New York and of those in South Brooklyn a few weeks ago.—*Fire and Water.*

Electric Lighting of Railway Stations.[1]

Lighting by electricity has been greatly extended in the last few years wherever there are large spaces which it is necessary to light well, especially for night work requiring continuous lighting for a long time. To-day nobody doubts the great advantages which powerful electric lights offer for the lighting of large open spaces, and in general all areas where a very large quantity of light is required. These advantages also exist in a certain degree for the large gas lights already mentioned, but the lighting power of these last rarely reaches 300 candles, while electricity permits the convenient employment of lamps of from 400 to 5,000 candles, and in lighthouses even up to 10,000 candles, which can be placed at any height desired. It is also well known that a large quantity of light is most economically obtained from the more powerful lamps. Incandescent lamps are only one-tenth as economical as arc lamps of 1,000 candlepower. The cost of the electric light has a special importance, because it is often the increase of expense which decides whether to adopt or reject this kind of lighting, and when once a system is established, there should be a very serious reason for changing it. This cost bears a direct ratio to the yearly number of hours of lighting. According to the calculations of M. Decker, of Nuremburg, the electric lights can not be economically used except where at least 2,000 hours of lighting per year are required. If 2,000 hours or more per year are required, electricity can compete with gas, if the price of the latter exceeds $1.13 per 1,000 cubic feet; gas is the more economical when the price is below 68 cents per 1,000 cubic feet.

In Germany electricity is in use or has been tried in more than 40 stations, of which the most important are Strasburg, which has 70 arc and 100 incandescent lamps; Carlsruhe, 24 arc and 250 incandescent lamps; Darmstadt, 17 arc and 170 incandescent lamps; Scheldt, 59 arc lamps; Munich, 47 arc lamps; Hanover, 24 arc lamps.

In England the most important installations of the electric lights which have been made for this purpose are the Tilbury docks and the stations of St. Enoch, Glasgow, Paddington, etc. In the Liverpool street station of the Great Eastern railway electricity supplements the lighting by gas.

In Austro-Hungary data have been published relating to two stations lighted by electricity, viz: Budapesth and Feldkirch. It is believed there are but three others, those of the State railroad, the Sudbahn and Westbahn in Vienna.

The state railroads of Belgium have 17 installations, comprising 163 arc and 322 incandescent lamps. The Grand Central of Belgium has lighted the station of Lodelinsart with electric arc lamps since 1882.

In France its use is more rare. The principal ones mentioned are the freight station of La Villette and the passenger station of the Eastern at Paris; that of La Chapelle Triage by the Northern; a part of the stations at Paris and Marseilles, and the stations at Bellegarde and Laroches-Foron by the Paris, Lyons & Mediterranean.

In Italy electric lighting is employed in two stations at Milan, one each at Turin, Sampierdarena, Genes-Place-Principe, Pisa and Rome.

In general, arc lamps are used for the lighting of large areas, both open and covered. Apparatus using continuous currents is preferred, because even without reflectors these lamps throw the larger part of their rays downwards. Where alternating currents are used it is because these installations are already in operation and the expense of changing would be considerable. Many different kinds of arc lamps are in use for railroad purposes, among which may be mentioned those of Siemens, Piette and Kusik, in Germany, Austria and Italy, Gramme and Cance in France, Crompton and Brush in England, Jasper, De-Puydt and Dulait in Belgium.

1. Abstract of a report to the International Railroad congress presented at the Milan session, 1887.

Incandescent lamps are usually Swan or Edison. The height and distance apart of the lamps at the different stations reported varies greatly. For example, at Liverpool street station Brush lamps of 2,000 candle power are placed 13 feet high and 115 feet apart; at the Sampierdarena, where the tracks used in making up trains are lighted, Siemens lamp of 9,400 candles are 13 feet high and 100 to 130 feet apart, and at Strasbourg the Siemens lamps are placed 65 feet high, and at Schaerbeek 128 feet high.

It is very difficult to procure data of the cost of installation or maintenance of electric lighting. Some of those reported in detail are given below: "Fifteen Brush and 15 Cance lamps, fed by a Brush machine in the station of La Villette, cost $32,000, but this includes a second Brush machine in reserve. At the Lodelinsart station electricity was substituted for gas, as already mentioned, in 1882. The station is lighted by 5 Gramme lamps of 3,100 candles each, and four Siemens lamps of 440 candles, besides 16 incandescent lamps of 235 candles each, the power being obtained from the engine running the locomotive repair shops. The installation cost $8,922. Operating the lights for 3,650 hours per year cost $209.60 per lamp per year. Gas in 1882, before the adoption of electric lighting, cost $3,283. In 1886, the cost of lighting was $2,708, of which $140 was for gas. The lighting of the station was not only greatly improved, but the cost was materially lessened.

The Liverpool street station of the Great Eastern is lighted partly by gas and partly by electricity. Of 33 electric lamps, 27 are Brush lamps, placed 110 feet apart. There are also 183 gas jets of 16 candle power each. The cost per lamp was for electricity 6.4 cents, and for the gas .5 cent, supposing all the burners used. The cost of the electric lighting should be somewhat reduced, because the machines are used during the day for incandescent lighting in the offices. At Strasbourg station it is calculated that each arc lamp replaces 25 gas lamps, each burning 5.3 cubic feet per hour, and each incandescent lamp replaces one gas lamp. The total cost of each arc lamp is 5.75 cents per lamp hour, and each incandescent lamp .46 cent per lamp hour. Gas would cost .72 cent per lamp hour. There is, therefore, a very considerable economy in lighting by electricity at this station.

At Feldkirch the dynamos are operated by steam engines of 35 horse power. Installation cost as follows: Buildings, $10,600; boiler and engines, $7,100; electric machinery, $9,150; lamps, $1,150; total, $28,000. There are 24 arc lamps and 130 incandescent lamps of 16 candle power. The cost of operation for the arc lamps was $927, of which 35.7 per cent. was for wages and salaries, 31.1 per cent. for fuel, 21.9 per cent. for miscellaneous expenses; repairs, etc., 11.3 per cent. The operation of the incandescent lamps cost $1,381, of which 40.7 per cent. was for wages and salaries, 13.1 per cent. for renewal of the lamps, 29.50 per cent for fuel, 15.1 for miscellaneous expenses, and 1.6 per cent for repairs. The division of expenses among the arc and incandescent lamps was made in proportion to the motive power necessary, and was respectively 25.5 and 12.4 horse power, or about two to one. If one arc lamp be taken equal to 15 incandescent lamps, the cost of operation per lamp hour is .39 cent.

Geo. W. Blodgett, electrical engineer of the Boston and Albany railroad, contributed a paper bearing on this subject to the same congress and showing what has been done by that road. An abstract is appended:

At East Boston the following points are lighted by electricity: First, the grain elevator, which has six lamps in a single line opposite the scales where the grain is weighed; secondly, freight houses numbers 6, 12 and 13 on the east; and freight house number 5, pier number 1 and entrance on the west, where ocean steamers load and discharge their merchandise or freight to the cars; thirdly, a coal wharf near the elevator, where the coal from the vessels is discharged into the cars on the tracks 10 feet below; fourthly, two engine buildings, one for the elevator engine and the other for the electric light engine. There are also several lamps in the yard near the most important switches and crossings. All

these lamps are Brush lamps of 2,000 nominal candle power. In the buildings they are placed 14 feet high, which was the greatest height which the construction of the buildings permitted. Out of doors the height is 24 feet. Although there are 48 lamps, only 36 can be operated at the same time, which is the full capacity of the dynamos. Each lamp can be extinguished by a switch when it is not needed. It is sometimes necessary to use a larger number of lights than can be operated by the dynamos. A choice is then made of those most indispensable, and the lightiug is completed by gas or oil lamps furnished with reflectors.

Electric light is used only when the number of lamps needed is nearly the capacity of one dynamo; that is to say, 18. When only two or three are needed, the gas is used.

The cost of the electric apparatus at East Boston, in place, was as follows: Buildings, $3,116.12; 60 horse power engine, in place, $1,737.10; shafting, pulleys, etc., in place, $364.29; belting, $412.30; two Brush number 7 dynamos, $4,000; 44 lamps, with two sets of of carbons, $3,520; two regulators for the dynamos, $250; wires, insulators, telegraph poles and cross-arms, and labor in setting up the machinery, lamps and wires, $1,322.75; total, $14,722.56. The boilers used for the elevator engines also supply steam for this, and the cost of boiler, or boiler house is therefore omitted from these items. The cost of operation during the year ending September 30, 1886, was $2,277.34, or $7.28 per day, or 20 cents per lamp per day, assuming 36 are used. This includes fuel, but not cost of boiler or boiler house. The lamps are used irregularly. When a vessel is at the wharf they are usually burned the whole night until the loading has been completed, when they are, perhaps, not used again until another vessel arrives, if it be delayed, unless the elevator is to run at night, or cars are to be unloaded. Two men arc employed to run the engine and dynamos during the night, and replace the carbons in the lamps during the day. They work as many hours as is necessary—sometimes 20 hours or more in the day, when the lamps burn all night, and sometimes only four or five hours. The average is about 10 hours for the whole year. When the electric lamps are not used, these men are employed in repairs, and other work for which there is not time when the lamps are used many hours.

At Boston the passenger station, train house and yard, are lighted by 33 arc lamps and 12 incandescent lamps. There are two Brush dynamos of 16 lamps each, and as they are run at a speed of 825 in place of 750 turns per minute, 18 lamps can be used instead of 16. They are placed at a height of 12 ft, except 5, which are about 24ft. high. Four men are employed; two renew the carbons and make repairs to the apparatus during the day. Two others work at night; one for the boilers and engine, and another who operates the dynamos and patrols the circuits to see that all lamps burn properly. The lamps have double carbons, and can burn all night. They are lighted as soon as it begins to be dark in the station, and run until after the arrival or departure of the last train. The station is lighted in the morning an hour before the departure of the first train. In summer the morning lighting is not necessary.

The cost of the apparatus, not including the engine or boilers, which are used by the repair shops, was as follows: Two brush dynamos, $4,000; 33 double arc lamps, $2,640; 2 single arc lamps, $120; 2 automatic regulators for the dynamos, $250; wires, insulators, fixtures, etc., and work of setting up the apparatus, not including the main shafting, etc., $1,206.47; total, $8,216.47. The cost of operation for the year ending September 30, 1886, was $6,465.11, or $184.72 per lamp per year, or 50.6 cents per lamp per day. The cost per lamp hour under these conditions was about 6 cents. The cost of power furnished by the motive power department is $2.50 per day, besides the wages of the engineer. Carbons cost about 80 cents per day; oil waste, etc., about 3 cents per day. The cost of repairs to 5 Brush machines during the 6½ years of use has not been, it is estimated, more than $150. Neither a lamp or dynamo has yet been replaced or sent to the factory for repairs. All such have been made by the men in charge of the apparatus. These installations were the first by a railroad company in New England, if not in America, and are still the most extensive. At Worcester the passenger station is well lighted by 20 arc lamps, placed about 15 feet high in waiting rooms, and 24 feet in the train-house. The cost is about twice as much as formerly paid for gas, which was never satisfactory, but several times the amount of light is obtained. The cost is 70 cents per lamp per night. It costs about the same at Springfield. At Pittsfield the electric light compauy light the passenger station for the same price formerly paid for gas, about $1,400 per year.

CORRESPONDENCE.

New York Notes.

New York, Jan. 7.—The first annual report of the Board of Electrical Control, prepared by Commissioner Gibbens, was read and unanimously adopted at a meeting of the board held yesterday. The report reviews in detail the work that has been done on the subways, showing remarkable progress during the five months of last year which the law creating the board left for that work before the closing of the streets against new excavations. There have been excavated for the laying of subways 189,918 feet of trench. For the telegraph and telephone service 903,180 feet of single ducts have been constructed, and as the average capacity of each duct is estimated at 80 wires, the total capacity reaches the enormous figure of 13,700 miles. For arc light and power service 254,250 feet of single ducts have been laid, capable of accommodating nearly 500 miles of wire, and for incandescent lighting 186,745 feet of conduit have been built, having a capacity for about 106 miles. This already gives New York a much greater capacity of conduit than that provided in any other city in the world. Nearly 2,000 miles of wire are now working successfully in these conduits, more than 1,000 miles of which belong to the Metropolitan Telephone and Telegraph company; the preparations are underway for very largely increasing the amount. The actual number of poles removed from the streets as a result of the work of the board is 217, and about 500 miles of elevated wire has been taken down. All companies having pole lines on streets where conduits have been constructed have been notified to remove their poles and wires within ninety days, and in case of failure to comply with this order the law provides for removal by the city authorities. A system of inspection of the subways and the wires within them is being devised. Mayor Hewett interrupted the reading of the report at the mention of the name of a district messenger company to ask if there was any law or ordinance to justify persons coming into a man's house or stringing wires across his roof without his consent. He said that recently a man called at his house and displayed a badge and said he was going upon the roof. The mayor evidently has not had much experience with linemen, else he would know that they do not depend upon laws and ordinances but upon "cheek" when they want to get upon a man's house.

A horse drawing a street car was killed last week at the corner of Fourteenth street and Fourth avenue by the current from an electric light wire. A wire on a Brush circuit had fallen into the street and the horse being driven against it was instantly killed. An accident of the same kind occurred last month at Stapleton, S. I. This matter of killing horses and men on account of poorly insulated wires is a serious one, and it is a pity that worthless insulation has heretofore been the rule for pole lines. But that the lighting companies appreciate their position, and are not waiting to be compelled to use good wires, is shown by the adoption recently by large companies of such high-grade wires as the Callender and Okonite.

J. T. Moriarity, an electrician of Boston, has engaged to fit up the sleighs of some wealthy Newton gentlemen with electric lights. He proposes to use storage battery cells to operate lights of six candle-power each. The Newton people take pleasure in anticipating the grand spectacle of a procession of electrically illuminated sleighs, with beautiful colored lights reflected upon the white snow, and are already talking of sleighing carnivals. But one objection might be raised to a brilliantly lighted sleigh, and it is well put in the following from an editorial article on the subject: "And, what is more and most of all, the pleasant sleighing parties of two, he and she, the engaged couple and the couple engaged in the fascinating diversion of getting engaged, must not be disturbed and illuminated against their will by the rapid and unexpected striking of these infernal electric flashes. In the name of all the young men and young women who are brought up and who make love in the honest country fashion, in the name of the millions in whose ears the sleigh bells have rung or yet shall ring a marriage chime, we protest against hanging this glaring and vulgar blazing breastpin upon the snowy shirt front of the winter night. The innumerable kind eyes of the sky wink knowingly at the innumerable pairs of lovers sleighing and loving. What in blazes, if we may use a rude but lucent expression, do *they* want with lights of six candle power? We advise these wealthy Massachusetts conspirators against a privacy and a privilege dear to millions of their countrywomen and countrymen, to hold back from their unwelcome illumination. The electric light is sometimes a convenience, but there are situations which it distinctly does not improve."

The report of the assembly telephone investigating committee will be submitted about the first of February. A number of the committee states that they will report that in some places the rates are excessive as compared with the incomes of the companies, and that the service in New York is as good as could be expected under the circumstances.

At New Brunswick, N. J., the gas company and various electric lighting companies have been trying for some time to secure a franchise for the lighting of the streets by arc lights. But the board of alderman day before yesterday finally refused to grant any franchise, and gas will be used as heretofore.

The Long Island Electric company operating the electric road between Brooklyn and Jamaica, has elected Col. A. A. Degrauw president of the board of trustees.

Bell stock jumped up 15 points on a sale last Monday, and immediately a rumor was circulated that the decision of the justices of the supreme court would surely be in favor of Bell. But it proved to be a baseless rumor. One broker states that he has been doing his utmost for weeks, personally and by agents, endeavoring to get an inkling of how the judges stand, and that he has not been able to learn a single thing, though willing to pay handsomely for authentic information. A.

Detroit's Budget.

Detroit, Jan. 7.—Five years ago, the Grand Rapids common council granted an exclusive franchise for fifteen years to the Grand Rapids Electric Light & Power company. The plant of company was not very extensive, and little or no business was done. Some time ago the Edison people organized a company, with $125,000 capital, and put in an extensive plant. When almost ready to light the city, the Light & Power company petitioned the United States court for an injunction restraining the Edison company from stringing wires through the streets. Judge Severens granted the injunction, but realizing the importance of the case, did so with the understanding that it should be heard by the three circuit judges, sitting in Cincinnati. These judges declared the ordinance granted the Light & Power company void, as far as relates to an exclusive franchise, and dissolved the injunction. The Edison company will now push the work to completion.

The Owosso Edison Electric Light & Motor Power company, capital, $20,000, has been organized, and will begin work at once. C.

From Salt Lake City.

Salt Lake City, Utah, Jan. 6.—The United Electric company of this city has just fitted the Cullen house of six stories with the Western Electric company's return call system of bells and a Brush-Swan incandescent light plant. This hotel is one of the most complete in the west.

The Butte City, Montana, electric light plant has been leased to John Tupper, formerly of this city but more recently electrician of the Helena electric light plant.

E. P. Roberts, manager and electrician of the Cheyenne Brush-Swan electric light plant, has arranged to put in an arc plant of the Western Electric company's system in Ft. Collins, Colo.

The Rocky Mountain Bell Telephone company is largely increasing its lines in Montana and especially in Helena where there are 225 subscribers to the exchange. The company is now figuring on connecting Great Falls and Ft. Benton with Helena—a distance of one hundred and forty miles.

The telephone line in Wahsatch mountains between Park City and Alta, Utah, completed last fall, is now buried at one place thirty miles from Salt Lake City under about twelve feet of snow, piled on it by three separate snow slides.

At the present time the Rocky Mountain Bell Telephone company have in operation about eight hundred miles of extra territorial lines. The total number of subscribers to their various exchanges in Idaho, Montana, Wyoming and Utah is about 1,500 and business is rapidly increasing all through their territory. C.

The Denver Electric Light Station.

DENVER, Colo., Jan. 6.—The electric light station at Denver, supplies current on three different systems: The Brush arc, Edison municipal, and Westinghouse alternating.

The latter is a recent installation, and to meet present requirements there are two number 1, and three number 2 Westinghouse alternating dynamos, each driven by a separate engine. There are also two constant current dynamos, each driven by a separate small engine. One of these is used to excite the fields of the alternate current dynamos, the other being kept as a relay. The number 1 alternating current dynamos generate an e. m. f. of 1,000 volts, and have a capacity for 650 16 candle power lamps each. The number 2 alternating current dynamos generate the same e. m. f., and have double the capacity.

The switch-board is arranged with two systems of 'bus conductors, each system being divided into six sections, which may all be connected in series by switches, so as to form two continuous systems of 'bus conductors, or otherwise divided into sections as may be required. The mains are so arranged that they may be connected separately, to either the upper or lower systems of 'bus wires, three to each section. By means of this switchboard, the load may be conveniently divided among all the dynamos, or any of them, or the whole of it may be shifted to either of them, without disturbing the lights. The dynamos may be run in multiple on combined load, or each one may carry its proportional part separately. The latter method has been found the more convenient in practice, and is therefore adopted in this station. By so doing, if any leak or cross should develop on one main, it may at once be isolated from the others, and tested with a separate dynamo, and a sudden break down on any main would not affect the others, as it would in the case of a complete multiple system. The field of each alternating dynamo is controlled by a separate resistance box, and likewise the field of each of the exciters.

Each alternating dynamo is provided with an ammeter, and each main with a pressure indicator. These indicators are not connected to centers of distribution by pressure wires, as commonly practiced, but are connected to the mains where they branch from the 'bus wires. They are however arranged to show the pressure on lamps by means of a very ingeniously contrived compensatory apparatus, that is interpolated in each respective main, and so connected to the indicator that the current, passing on the main, re-acts on the indicator, and holds its pointer at zero, when the proper e. m. f. is maintained at end of main, to keep a varying load of lamps at correct candle power. As, however, the mains have only about two per cent loss at full load, the extent of this variation is small, and no main equalizing coils are required.

The mains are formed of duplex lead covered cables, made by the Standard Underground Cable company, and there are eighteen or twenty of these, each from half a mile to a mile and a half long, laid underground from the station to various points in the city.

The end of each main is brought up to the top of a pole through a wooden casing, and is there connected, through a switch, to a branch main stretched on poles through the alleys that run between the blocks; these branch mains forming a T-end to each underground main.

The converters are fastened up on the back walls of the houses, on the outside, and are connected in multiple to the branch mains. In this way, each main, with converters connected, forms a separate system in itself.

The secondary wires of converters carrying a reduced e. m. f. of 50 volts are connected to the house wires leads to respective group of lamps, so that each group of lamps is also in a measure, a separate system in itself, and should a ground develop in any house it can only affect that particular group.

In order to provide against a lengthy extinction of lights at end of any underground main on account of accident thereto, there are provided two independent conductors called tie-mains, each of which embraces one half of the entire system, and may be connected to any of the branch mains by switches. Should accident happen to any of the regular mains, the connection through switches to branch mains would be broken and the branch main so cut off would be connected to the tie main, thus providing current for the branch, until the underground main can be repaired.

In this system it has been the aim to separate as much as possible the different parts of the whole, making each part self-dependent, and independent of other parts, so that accident in one place shall not affect the rest of the system, but be observable only in its immediate vicinity. And herein it differs from multiple arc systems in general, the various branches of which are usually connected and bridged together as much as possible in order to produce an equality of pressure throughout the system with a minimum amount of copper. N.

From Kansas City.

KANSAS CITY, MO., JAN. 7.—It is no vain boast to say that Kansas City is the best illuminated city of 173,000 population in the world. There are at least 1,000 arc and 8,000 incandescent lights now in use within the corporation. The superintendent of the Western Electric Construction company reports that during the past year he has superintended the putting up of wires for over 6,000 incandescent lights which are now being used, and for about 4,000 incandescent lights which will be in use within three months. All the large office and bank buildings under construction will be furnished with these lights. The Kansas City Electric Light company runs by means of wires extending from its plant, at Eighth and McGee streets, 625 arc and 700 incandescent lights, an increase of 313 over last year. Of the arc lights 50 are used by the city.

The Edison company furnishes 660 incandescent lights—600 to the Coates house and 60 to the Commercial club. Within a few days it will increase the number by 300, all of which will be in the new *Journal* building at the northwest corner of Tenth and Walnut streets.

Among the buildings in which there are motors, and which do not depend upon either of the companies named, are the following. The numbers given are for incandescent, and are exclusive of electric lights: Nelson, 750; Grand Missouri hotel, 150; Custom House, 350; *Times* building, 500; Grand Avenue Cable company's engine houses, 150; Warder Grand Opera House, not yet all in, 1,500; Metropolitan Cable company's engine houses, 100; Kansas City Cable company's engine houses, 100; Landis court hotel, 800; Centropolis hotel, 750; Dime museum, 150; Gillis Opera House, 500; Bonaventure hotel, 350.

Three Electric Light companies obtained franchises from the city council during the year, the Edison being one of them. The other franchises were granted respectively to Matthew S. Porter, Horace M. Porter and others, and to James M. Hallett, A. L. Ellis and others.

The Edison company now has its headquarters in the building of the Kansas City Electric Light company, which now operates the local plant of the Sperry Electric Light company. The Edison company will erect a building at the corner of Ann and Wall streets, in the rear of the old *Journal* building, in the spring. Its engines will have a total capacity of 1,800 horse power. Motors, ranging from one-eighth to sixty horse power will be supplied to customers. The franchise was obtained under the name of the Edison Electric Light & Power company. One of the conditions under which Matthew S. Porter *et al.* were granted a franchise was, that they will operate one arc light in each of the fire engine houses they pass within one block of their territory, and also in each city park that their wires run through or within one block of. James M. Hallet *et al.* are required to light free all engine houses, parks, market houses and police stations that their wires run within one block of. Matthew S. Porter *et al.* have begun erecting their engine house upon the Southwest boulevard.

The total cost to the city for lighting the streets and its buildings during the year was $47,233.43, as against $40,160.92 in 1886. The average monthly expense for lights in 1886 was $3,346.75; in 1887, $3,936 12, and the average daily expense was $111.56 and $129.4, respectively. The city's gas lamps number 1,140, the gasoline lamps 810 and the are lights 50. This is an increase during the year of 140 gas lamps, 8 gasoline lamps and 18 arc electric lights. The council has authorized 14 additional arc lights, which have not yet been put in position. The Kansas City Cable Railway company operates three arc lights on the streets, the Chicago, Milwaukee & St. Paul railway company one, the Kansas City, Fort Scott & Gulf railway company one, and the Kansas City Electric Light company three. In addition to these a large number of arc lights are hung in front of stores, hotels, manufacturing establishment, theatres and saloons, and serve to dispel the darkness. Within doors many firms make use of arc lights to the exclusion of all others. C.

From Indianapolis.

INDIANAPOLIS, Jan. 8.—The Plymouth city council has entered into a contract with the Jenney Electric Light company, whereby the company is to furnish the city with electric light for street purposes for one year, and is granted an exclusive franchise to furnish light to private consumers for a period of ten years.

At Delphi, Ind., an electric lighting company has been organized, and will shortly make application for articles of incorporation. The company proposes to furnish light for streets, business houses and dwellings.

The city council of Brazil, Ind., has contracted with the electric light company there, for 30 lights for streets; this is an addition of 12 lights over last year's contract. The lights have proved a success. Charges are $60 per year each.

At Lafayette, Ind., January 2d, Judge D. P. Vinton, of the Tippecanoe circuit court, rendered a decision in favor of the plaintiff, in the case of Falley vs. the Central Union Telephone company, holding that the tolls system, under which the telephone company is operating in this State, is an evasion of the law, and that the company must furnish telephones to patrons at the rate provided by the statute—$3 per month. An appeal will be taken by the defendants. This is the first decision in this State made on the question, on which a large number of suits have been brought at various points. M.

THE ELECTRIC LIGHT.

The Rome Gas Light company will build an electric light plant at Rome, Ga.

The Brush Electric company, Louisville, Ky., will make extensive additions to its plant.

Col. R. T. Coverdale, of Rome, Ga., will erect an electric light plant.

Captain Anson in summer holds down the first base for the Chicago base ball club and this winter is managing a racquet court; in both positions he is eminently successful. Recently he had the court fitted with four electric lights and

one of the committee who were agreed upon to decide as to the effectiveness of the illumination for the purposes of the place thus commends it: "The light is better than daylight on a dark day and it discounts sunlight when the sky is cloudless. The shadow cast is not as great as it is by sunlight. The electric lamps are suspended thirty feet above the players and therefore not in the way. A wire netting prevents breakage of globes."

The station of the Brush Electric company, at the corner of Seventh and Walnut streets, St. Louis, Mo., was damaged by fire January 7th, and some 500 lights cut off in the business part of the city. The loss of $10,000 is fully covered by insurance.

A. T. Grady will establish an electric light plant at Goldsboro, N. C.

New machinery for incandescent lighting is to be added to the Knoxville electric light plant. The company has recently reorganized and increased its capital stock. C. E. Dunstan, Knoxville, Tenn., is the President.

A. L. McLane is interested in an electric light plant to be established at Laredo, Tex.

The city of San Angelo, Texas, is to have a $10,000 electric light plant.

Howard Murphy is interested in an electric light plant to be erected at Bristol, Tenn.

Council Bluffs, Ia, has adopted the tower system of electric lighting.

Montgomery, Ala., has awarded a contract for the lighting of its streets, the arc system to be followed. As we understand it the contractors are to furnish and maintain 100 lights, at an annual total charge of $15,517.50, the agreement to last for five years.

THE ELECTRIC MOTOR.

In Asheville, N. C., motors will be used in several manufacturing establishments.

Dr. de Bausset of Chicago is another of those who have solved the problem of ærial navigation. He has designed an "aeroplane" which consist of an air-tight cylinder, made of sheets of very thin steel, cone-shaped at each end. By pumping part of the air out of this cylinder he obtains all the buoyancy needed. It will be propelled by electric motors, which can cause it to move in any required direction. The general movement will be in a series of inclined planes up and down in the atmosphere, somewhat resembling the course of a sailing ship in tacking, except that the tacks of the aeroplane will be in a vertical plane instead of a horizontal one.

THE TELEPHONE.

With the attacks of Chicago papers on the telephone service for a text the Omaha *Republican* of the 31st ult. takes the opportunity to say that, "so far at least as concerns the night service of the telephone exchange in this city, it is of the very best. The day service is doubtless equally good, but morning newspapers have use for the telephone almost exclusively at night, and so know best what it is at that time. The *Republican* uses the telephone from fifty to a hundred times each night. It is chronically in a hurry, and very rarely indeed has its patience tried. The operators are both prompt and accommodating, and frequently place the reporters under obligations in one way or another. The service might, in fact, be a good deal worse, and not leave room for complaint; it couldn't well be much better, and the *Republican* takes pleasure in this public recognition of the fact."

THE TELEGRAPH.

All the trains on the Lehigh Valley railroad, between New York and Easton are now equipped with apparatus for telegraphing while in motion. The operator's office is in the baggage car, where is also the apparatus for carrying the current by induction to the wires along the road. Western Union rates and ten cents additional will be charged for this service. The system will be put in operation over the entire Lehigh Valley line, and other railways are negotiating for the adoption of the system.

The tribunal of commerce of Paris has delivered a judgment ordering the French Cable company to conform to its agreements with the Anglo-American company and to pay all costs and a certain amount of damages per day for each day's delay in carrying out the agreement.

NEW ENTERPRISES.

Mrs. Thomas Bradley of Lexington, Ky. will make improvements in the Alexander hotel, that will cost about $8,000. Among other improvements electric bells will be put in. Walter Townsend will receive correspondence.

Conrey & Birley of Shelbyville, Ind., are about to erect new shops for the manufacture of center tables.

Miscellaneous Notes.

Argand, a poor Swiss, invented a lamp with a wick fitted into a hollow cylinder, up which a current of air was permitted to pass, thus giving a supply of oxygen to the interior as well as the exterior of the circular frame. At first Argand used the lamp without a glass chimney. One day he was busy in his work room, and sitting before the burning lamp. His little brother was amusing himself by placing a bottomless oil flask over different articles. Suddenly he placed it upon the flame of the lamp which instantly shot up the long, circular neck of the flask with increased brilliancy. It did more, for it flashed into Argand's mind the idea of the lamp chimney, by which his invention was perfected.

The new club house of the New York Electric club is now informally open and meals are served in the club restaurant. The formal opening of the house will take place this month.

Rumors of the indefinite postponement of the opening of the Brussels exhibition of 1888 are emphatically contradicted by the management, which announces that the inauguration will take place May 5th. All applications for space are to be refused after January 1st. Germany hast secured 10,000 square meters, Holland, 9,000, England, 20,000. Russia has 250 exhibitors, and the United States and Austria will be largely represented, but France and Belgium will make but little show; France having refused to take an official part.

Business Mention.

Very nearly 2,000,000 carbons were sold by the National Carbon company of Cleveland, O., during the month of December. Better evidence of the excellence of this company's products or of its popularity among purchasers could not be desired.

Watches made entirely of metals which are not affected by magnetism are now made by the American Waltham Watch Co., of Waltham, Mass. The manufacturers assert that the watches "are accurately adjusted and possess all the fine time-keeping qualities characteristic of Waltham watches."

The Western Electric arc light plant at the St. Louis exposition last fall operated so satisfactorily that the management decided to purchase it and make it a permanent fixture. The plant consists of 150 lights. The same company have sold to a New Orleans company a plant for a Mississippi river steamboat.

On the south side of Twenty-third street, rapidly becoming one of the busiest thoroughfares of this city, between Tenth and Eleventh avenues, says the New York *World*, describing the new factory of the Consolidated Electric Light company, stands their very handsome manufacturing and office buildings, six stories in height, covering thirteen city blocks, with a front on Twenty-third street of 325 feet. This property has recently been purchased by the company, which will establish at that point a manufactory of incandescent electric lamps, with a capacity of at least 10,000 incandescents per day, together with its general offices, which for the past three years have been located in the new Mutual Life building, at number 32 Nassau street. Six of the floors, each 50 x 220 feet, will be devoted to the factory proper, and the steam plant of several thousand horse-power will occupy the court yard in the rear. Two stories, 60 x 90 feet, will be occupied by the general offices, where will be found concentrated every department engaged in the practical business of incandescent lighting. The six other floors, 60 x 90 feet, will be utilized in the general business of the company, and together with the janitor's residence, the stables and workshops outside of the main buildings, make a property complete in every particular for all the purposes of its owners.

Electrical Patents.

Issued Jan. 3, 1888.

375,727. Electrical Synchronous Movement. Henry C. Bridger, New York, N. Y.

The invention relates to that claas of instruments in which synchronously-rotated trailing fingers, or circuit completers are caused to rotate concentrically over circular series of insulated contacts, as, for instance, in printing telegraphy and synchronous multiplex tele raphy.

375,749. Permanent Magnet for Electrical Apparatus. William Humans, Cambridge, Mass.

375,750. Armature for Magneto-Electric Machines. William Humans, Cambridge, Mass.

375,751. Magneto-Electro Machine. William Humans, Cambridge, Mass.

375,756. Lightning-Rod. Spencer R. Lawshe, Chicago, Illinois.

The first claim is as follows: "In lightning rods composed of sections containing a centre rod or wire and two or more outside wires made of steel or iron or other suitable material, a sheathing of copper or other suitable material, arranged in such a way as to separate the outside wires from each other and from the centre rod or wire."

375,766. Telegraph-Register. Joseph G. Noyes, New York, N. Y.

375,784. Apparatus for Electric Welding. Elihu Thomson, Lynn, Mass.

The apparatus is designed for heating curved forms such as wheel tires. The movements given to the ends of the pieces must be such that the form of the pieces shall be preserved when united. The pieces are accordingly given a motion through a curved line corresponding to the form of the object and the result to be attained.

375,835. Electric Exercising-Machine. Edward W. Robinson, Charles H. O'Brien, and Howard W. Breen, Portland, Me.

375,862. Telephone. V. Maximilian Berthold, Cambridge, Mass

The invention consists in a telephone having a galvanic battery located between the mouth-piece or sound-opening and the microphone contact and in various details of construction of the battery and of the box or case in which it is used, in combination with the microphone contact, by which ready access may be had to the battery without disturbing the adjustment of the microphone.

375,876. Conduit for Electric Conductors and Power-Cables. Isaac La Rue Johnson, Washington, D. C.

375,898. Duplex Telegraphy. Charles Selden, Baltimore, Md.

A third winding or auxiliary coil is provided upon the core of the neutral relay.

By means of a pole changer operated by the transmitter a local battery is momentarily closed through this extra coil at the moments of static charge and static discharge.

In this manner the magnetism that would otherwise be produced at such moments is neutralized.

375,910. Regulating Alternate-Current Electric Generators, Karl Zipernowsky, Buda-Pesth, and Maximillian Déri, Vienna, Austria-Hungary.

375,915. Electrical heater. John P. Barrett and Jacob F. Mehren, Chicago, Ill.

The invention is stated to be designed to utilize incandescent electric lamps for heating and cooking purposes. There are ten claims, the seventh being as follows: In an electric heater, the combination of the inclosing case, chamber or stove, the pivoted lamp holder, and sliding electrical connections therewith, substantially as set forth.

375,925. Telephone system. John Crawford, Reading, and John B. Ker, Harrisburg, Pa.

The claims are given:

"1. A double switch-board consisting of two boards placed back to back and both provided with plug holes, in combination with jacks situated between said boards, and the two boards being detachably secured together, substantially as set forth."

"2. A double switch-board consisting of two boards placed back to back and having jacks mounted on one of said boards with plug holes in both boards, said jacks being arranged in groups or sections, and the back board being removable for each of such groups or sections, substantially as set forth."

375,952. Covered or Insulated Wire or Conductor. Leonard F. Requa, New York, N. Y.

The invention is defined in the fourth claim as follows: A wire or conductor covered with a coat of balata and pyroxyline in successive tubular layers.

375,977. Supporting Arms for Electric Lights. Daniel B. Banks and George K. Hutchins, Baltimore, Md.

376,007. Electric Arc Lamp. William H. Miller, N. Y.

376,018. Electric Therapeutic Device. Edwin R. Whitney, St. Johnsbury, Vt.

376,019. Mould for Forming Pieces of Carbon for Electric Purposes. Charles H. Wilder, Natick, Mass.

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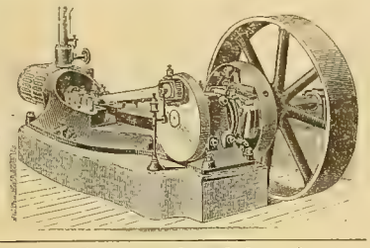

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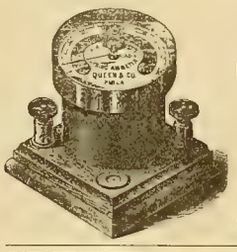

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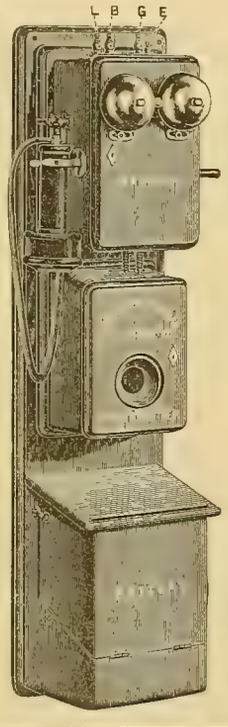

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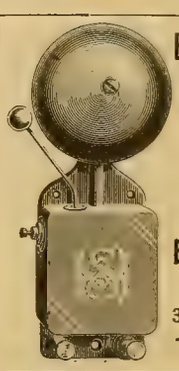

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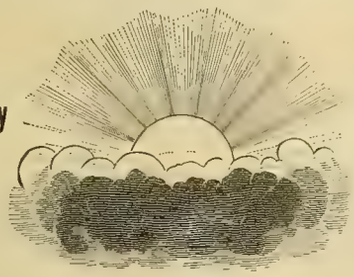

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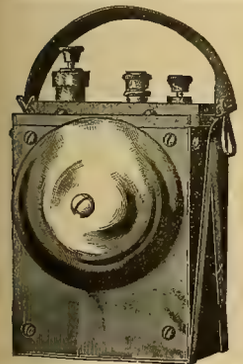

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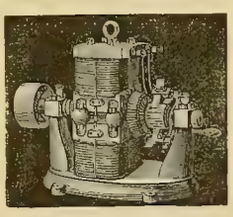

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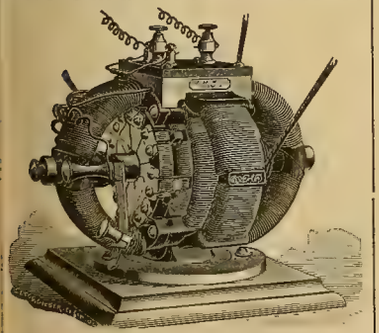

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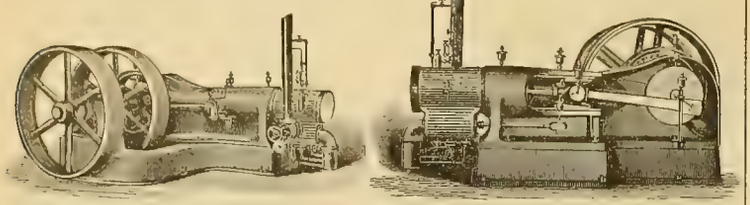

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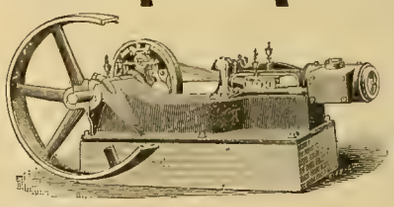

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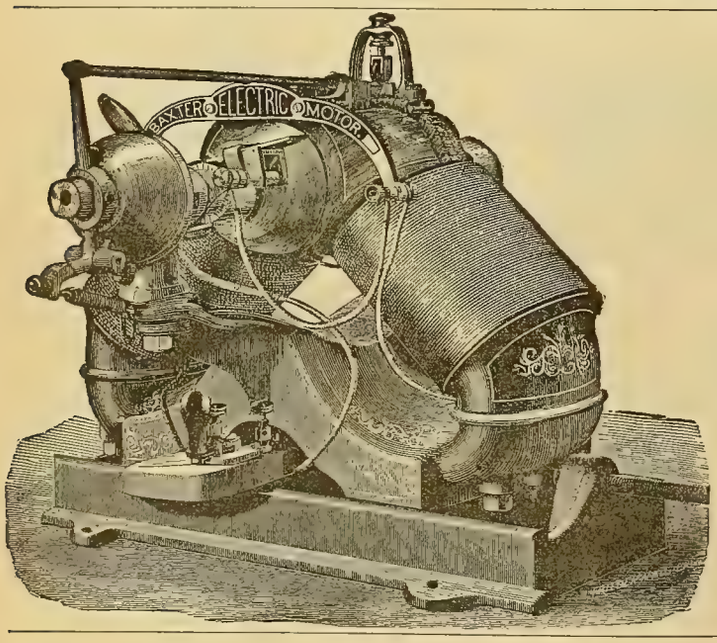

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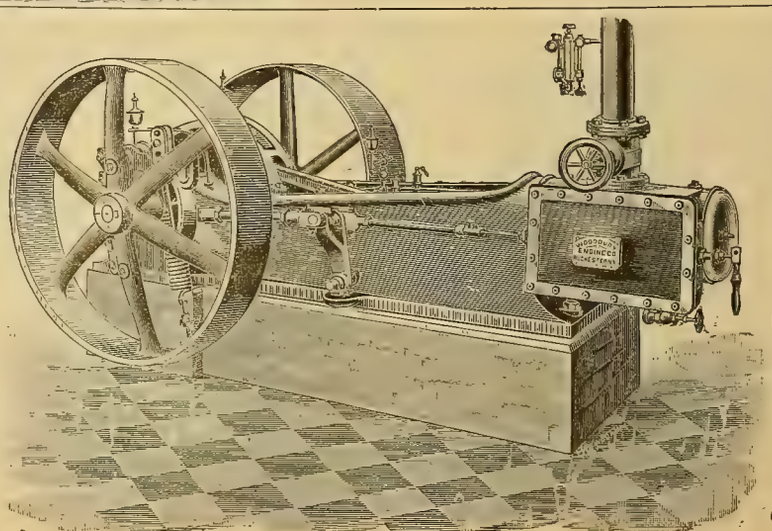

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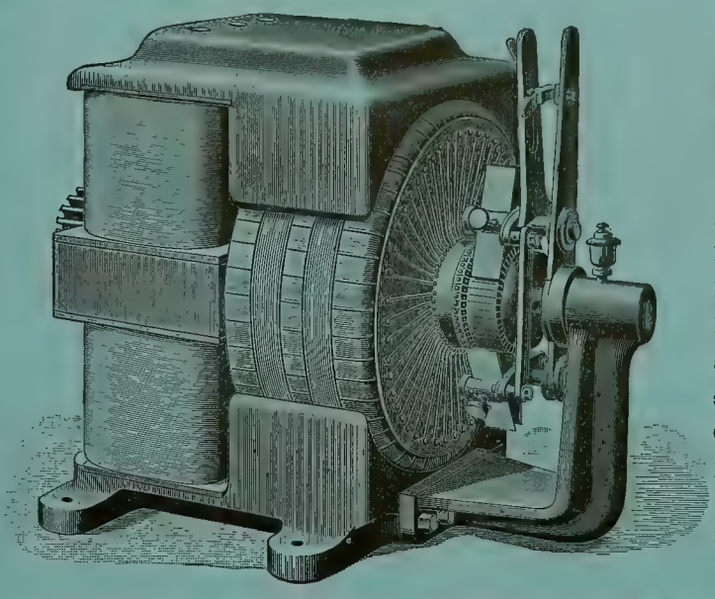

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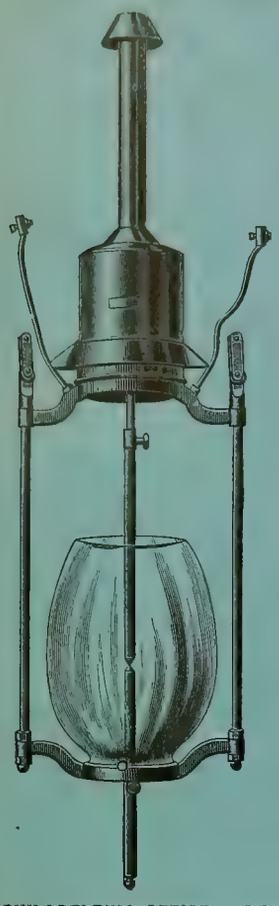

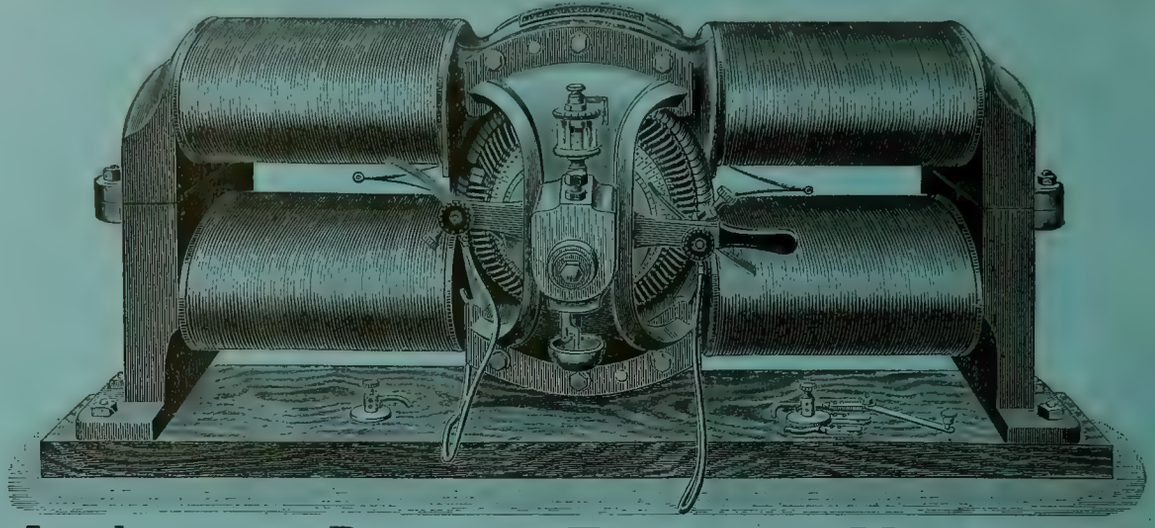

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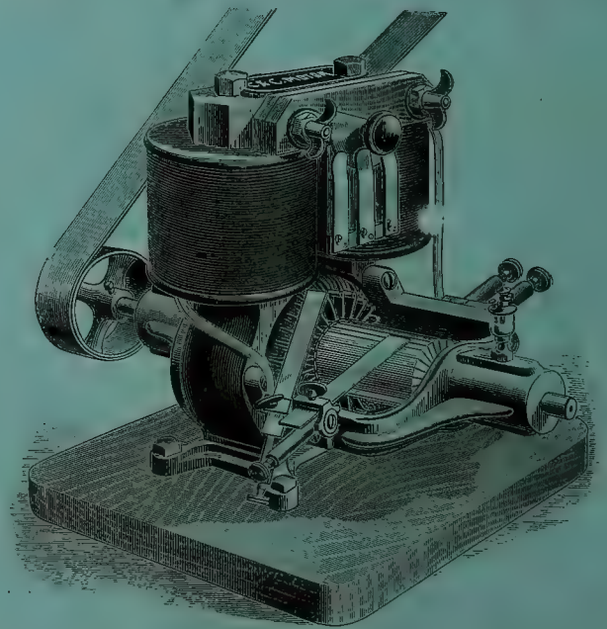

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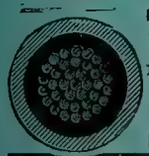

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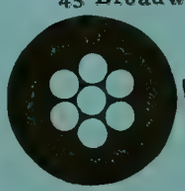

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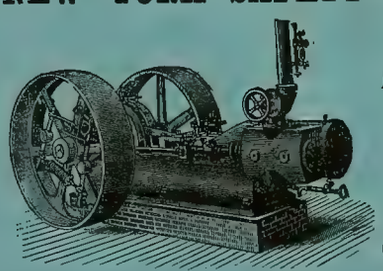

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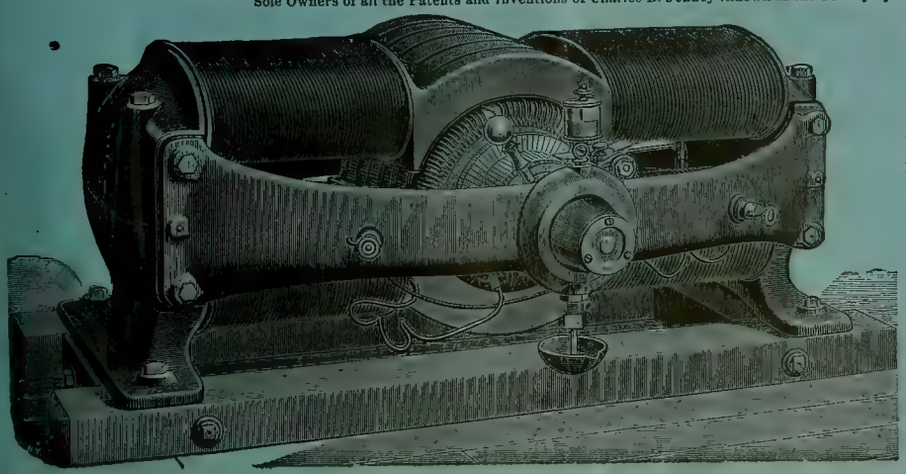

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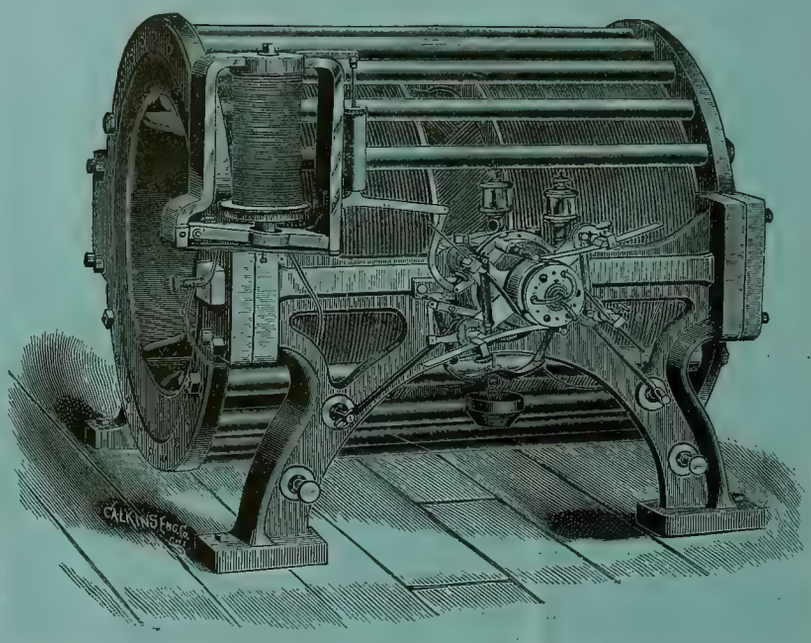

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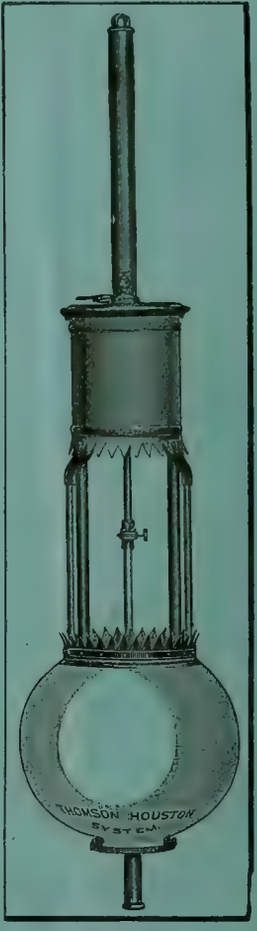

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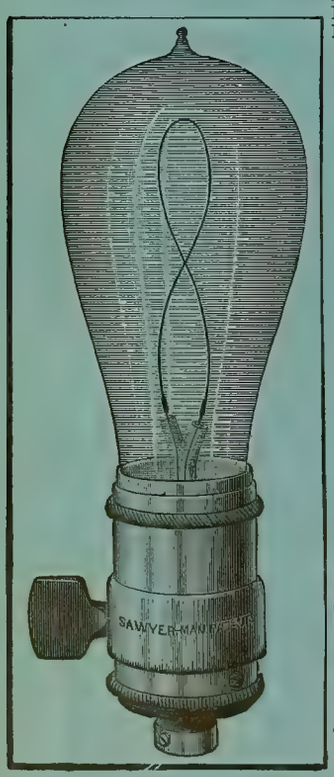

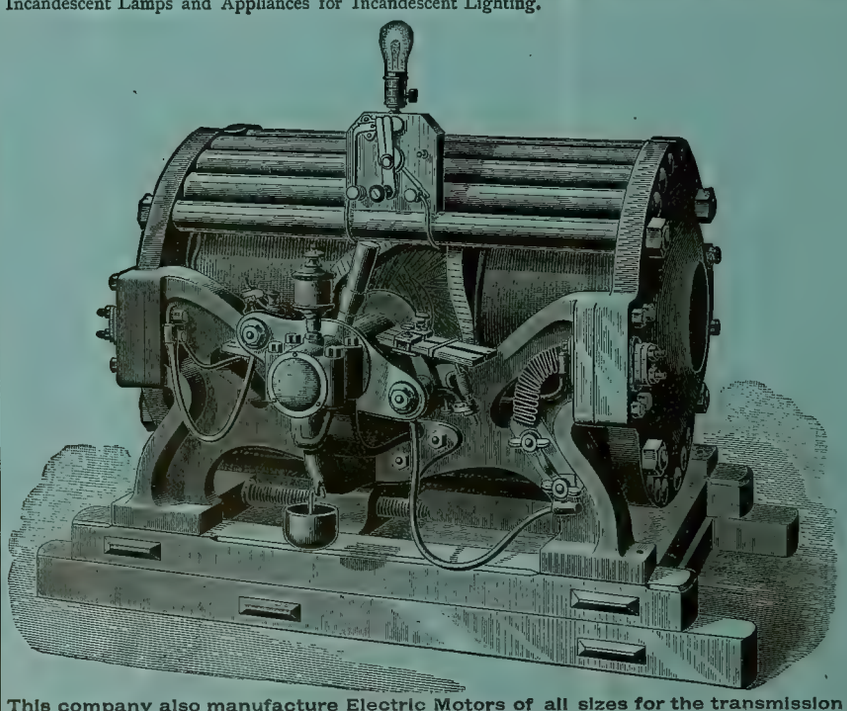

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12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

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Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

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Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

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He says, after having Careful Indications of Engines and Practical Electrical Measurements made, that

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U. S. 610 LAMPS REQUIRING 53 H. P.=11$\frac{50}{100}$ per H. P.
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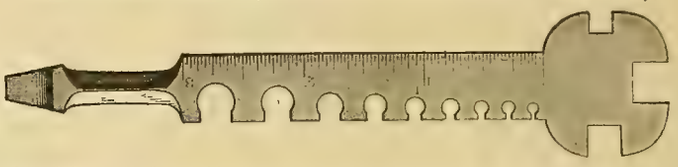

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FOR ELECTRIC LIGHT AND POWER.

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GENERAL OFFICES:

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32 NASSAU ST.,

NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:

No. 308 WALNUT ST

BOSTON OFFICE:

No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

EDISON'S OPINION.

Geneva Non-Magnetic Watch Company:

Gentlemen:—During the past six months I have submitted the watches containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring to test in different fields of magnetism. I find them exempt from magnetic influence, however strong, and practically no retardation of the balance, nor change in rate occurs, even when in actual contact with Dynamos or powerful Electro-Magnets.

I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

For Full Information about the Watches referred to in the above Testimonial, address:

Geneva Non-Magnetic Watch Co.

(LIMITED.)

177 & 179 Broadway, New York.

Holmes, Booth & Haydens,

25 PARK PLACE, NEW YORK.

MANUFACTURERS OF

Bare and Insulated WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk and Worsted Cords, for Incandescent Lighting. Round and Flat Copper Bars, for station work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT

"K. K."

LINE WIRE

For Electric Light, Telegraph and Telephone Lines.

TRADE MARK "K.K."

FACTORIES: WATERBURY, CONN.

J. L. BARCLAY, Selling Agent,
185 Dearborn Street, CHICAGO, ILL.

THOS. L. SCOVILL,
NEW YORK AGENT.

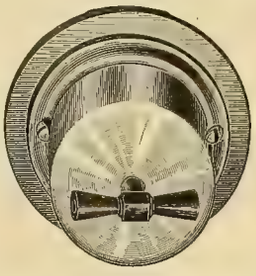
AGENTS FOR FOREST CITY AND OTHER CARBONS.

Forest City Electric Works,

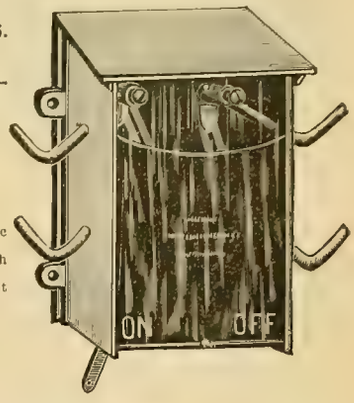
Manufacturers of CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.



Correspondence Solicited with Electric Light Companies.



W. B. CLEVELAND, Proprietor, 26 S. WATER STREET, CLEVELAND, O.

SHULTZ BELTING

MANUFACTURERS OF

Our BELTING is tanned on the surfaces only; the **INTERIOR is RAW HIDE.**

Send for Our Valuable Book for Engineers and Belt Users. Free.

Agents in all Cities. Send for Trial Belt.

Our Belts are the strongest, most even and perfect Electric Belts made.

ST. LOUIS, MO.

Gutta Percha Insulation.

Our Balata Insulated Flexible Cords

ARE SUPERIOR TO ALL OTHERS.

SEND FOR SAMPLES.

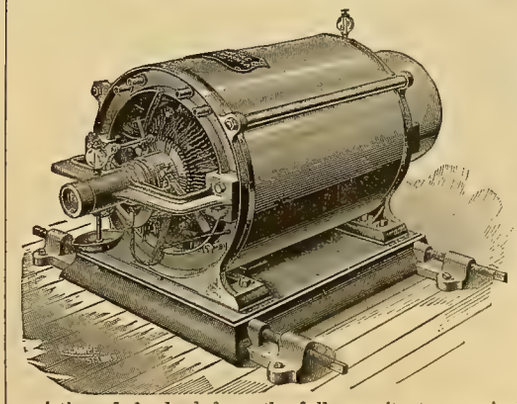
Heisler Electric Light Co.

809-817 S. 7th Street, ST. LOUIS, MO.

MANUFACTURERS OF

The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuies. To its production of nearly double the candle power to the H. P., as compared with any other system.

We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. ANTWERP. LONDON.

MANUFACTURERS OF AND DEALERS IN

Electrical Apparatus and Supplies

INCLUDING

Patterson Cables, Insulated Wire and Cordage,

Electric Bells, Annunciators and Push Buttons, Electrical Testing Apparatus, Watchmen's Clocks, Mercurial Fire Alarm, Factory Telephone System, Hotel Return Call and Fire Alarm, Telephone Switch Boards and Edison Electric Pen, Electrical Books, Magneto Bells, Police and Fire Alarm Boxes, Registers, etc., Telegraph Instruments, Batteries, Linemen's and Inspectors' Tools.

Washburn & Moen Mfg. Co.'s Line Wires. Cross-arms, Pins, Brackets, Insulators, Carbons, Arc Light Globes, Etc., Etc.

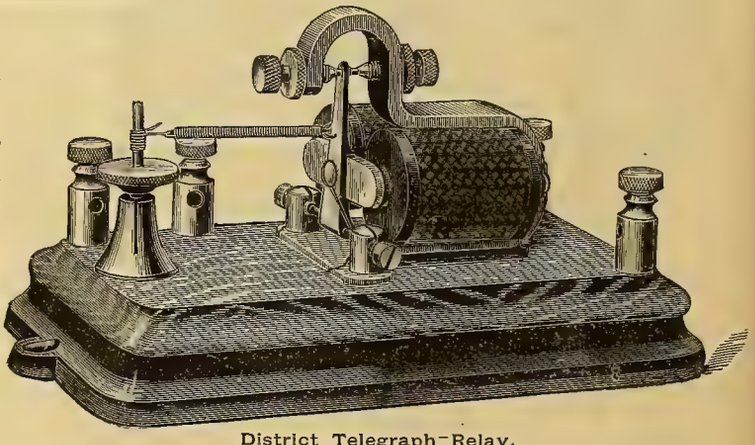
Electric Lighting Apparatus

OUR SYSTEM OF ELECTRIC LIGHTING IS COMPLETE IN EVERY DETAIL, AND IS UNEXCELLED IN THE EFFICIENCY AND WORKMANSHIP OF THE APPARATUS, IN THE BRILLIANCY, STEADINESS AND COLOR OF THE LIGHT PRODUCED, AND IN AUTOMATIC REGULATION. WE FURNISH DYNAMOS TO GIVE ANY REQUIRED CURRENT. THE HIGH GRADE OF WORKMANSHIP AND THE EFFICIENCY OF OUR DYNAMOS RENDER THEM SPECIALLY ADVANTAGEOUS FOR CHARGING STORAGE BATTERIES, FURNISHING CURRENT FOR ELECTRIC MOTORS, ETC. WE FURNISH ARC LAMPS ADAPTED TO ANY ARC CURRENT. THE SUPERIOR CONSTRUCTION AND SIMPLICITY OF OUR LAMP RENDER ITS USE ADVANTAGEOUS WITH ANY SYSTEM.

Field and Firman Call Box with Answer Back Bell.

We are licensed under the Field and Firman patents on Multiple Call Boxes with Answer Back Attachment, and caution users against infringements of these patents.

We manufacture District Telegraph Bells, Relays and Registers of the best construction.



District Telegraph Relay.

WE HAVE STILL A LARGE QUANTITY OF

KERITE WIRE,

Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even No. 16 gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes Nos. 13, 14, 15 and 16.

Western Electrician.

EVERY SATURDAY

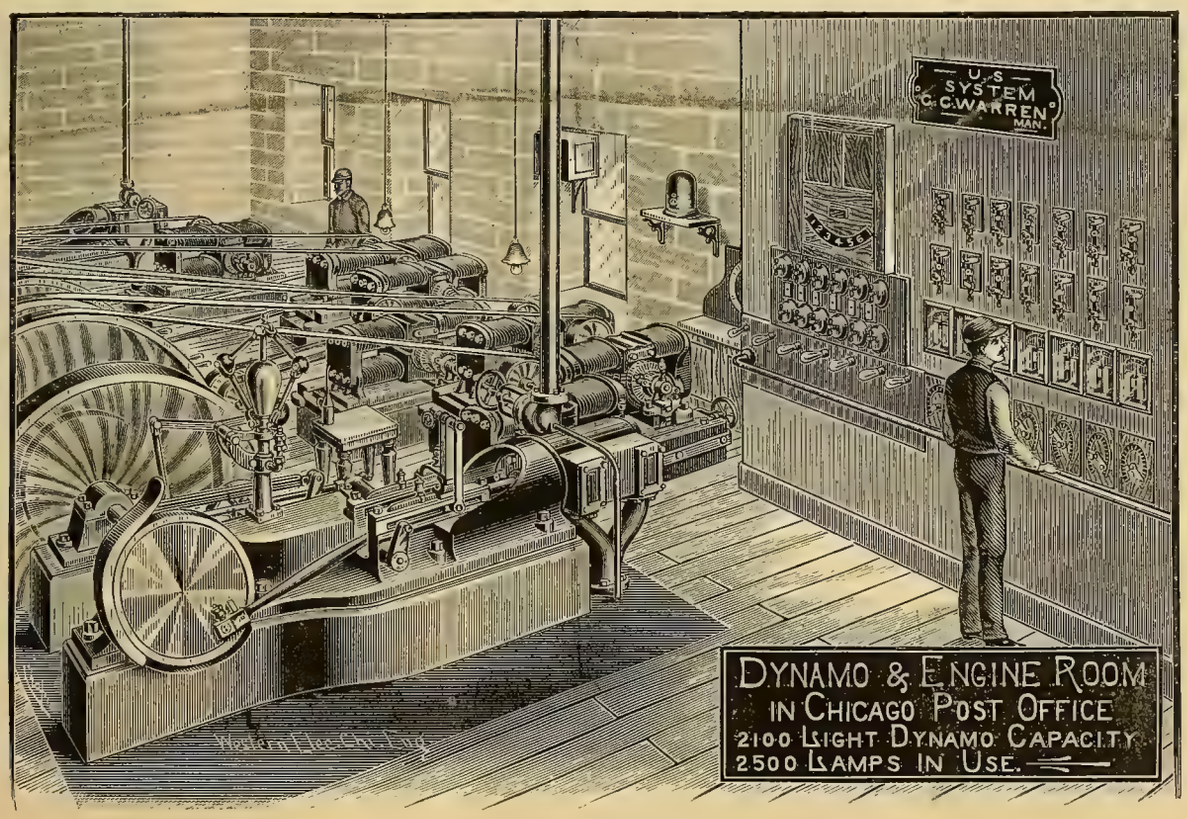
Vol. II. CHICAGO, JANUARY 21, 1888. No. 3.

The Chicago Post-Office Electric Light Plant.

In connection we show a handsome illustration of one of the largest, if not the largest, and best equipped incandescent electric light plant in the city of Chicago—that of the United States Electric Light company, installed by the western manager, C. C. Warren, in the United States custom house and post-office four years ago. The illustration shows the dynamo room as constituted at present. It is well to make this statement as the original plant consisted of 750 lights; the next year it was increased to 1,000 lights; one year ago to 2,500, with only 2,100 light rated dynamo capacity, and it may be that the end is not yet reached.

The steam plant consists of two independent batteries of boilers which furnish the steam for two Porter-Allen engines, one of 225 horse power and the other of 100 horse power, which move in proportion to the number of lamps burning. The engineer then throws one dynamo into use after the other. But just as suddenly the hands may travel back and the engineer will throw off the extra dynamos which are not required to run a smaller number of lights.

In a large lighting system like this, every precaution has to be taken to insure at all times an even illumination. Potential indicators indicate at all times the electrical pressure at the lamps. Ground indicators indicate whether the insulation of the lines is in good or faulty condition. Another instrument enables the attendant to find in a few moments the place where a wire should be grounded. The whole system of wiring is sub-divided, each division having an independent switch in the dynamo room. The dynamos and the circuits are connected in multiple arc and safety devices are provided to insure perfect safety everywhere.



are directly connected to a shaft by means of friction clutches. This arrangement enables the engineer to throw either engine on or off the shaft while it is running without interfering in any way with the light. On the shaft are seven friction pulleys which drive seven United States incandescent dynamos of 316 candle power light capacity each. A general switch-board in combination with the friction pulleys enables the engineer to throw any number of dynamos on or off in proportion to the number of lights burning.

Ampere-meters show at all times the amount of current generated by each dynamo as well as the number of lamps in circuit. It is very interesting to watch the movements of the hands of these ampere-meters at times. On a bright sunny day, for instance, when only a few lamps are burning in the building, a cloud may come up and obscure the sun for a few moments; then suddenly the hands of the ampere-meters commence to

Kennedy's Single Horse-Shoe Magnet Dynamo.

An English dynamo, invented by Rankin Kennedy, is described as a self-regulating, compound-wound machine, consisting of a single horse-shoe magnet, with an armature of the Gramme type.

The magnet core is of soft, hammered scrap iron, the pole-pieces of hematite cast-iron, and the armature core of soft, charcoal iron washers. The whole machine is exceedingly simple, strong, well-proportioned, and well built; and is claimed to be well adapted for use in factories, mills, workshops, and steamers, since it may be left in charge of any ordinary mechanic, or fireman, with a minimum chance of its getting out of order. All the adjustable parts are readily accessible, and the armature may be removed and replaced easily and rapidly when necessary. There is no perceptible sparking at the brushes, and the construction of the commutator and brushes is such as to insure easy adjustment and durability. None of the parts show any signs of undue heating, and the ventilation of the armature is all that could be desired. Its output is 10,850 watts, or 108.5 amperes, and its e. m. f. 100 volts, at 620 revolutions per minute, and the electrical efficiency 89.3 per cent. which is considered good for a cheap, practical, workshop, or factory machine.

High Speed Trunk Engine and Victoria Dynamo.

A steam engine and dynamo combined has recently been constructed in England by J. S. Raworth for use where the space is so limited as to afford barely room for an ordinary dynamo. The engine is of the trunk pattern as regards its piston, the trunk being formed of a hardened steel tube ground perfectly true and fitted at its center with the piston which works in a cylinder. Both sides of this trunk are carried through a gland fitted with metallic packing of a special construction, which makes it self-adjusting, and the lower end of the trunk projects through this gland into a closed chamber, which is drained to remove water. Inside the trunk is the connecting rod pin, of hardened steel, which is removable. The other end of the connecting rod is attached to the crank pin, and fitted with brasses having a large wearing surface. The crank is of steel, and forms also the spindle of the dynamo. The crank webs, after being slotted and finished, are fitted with iron counter-balances of such shape that when in place each crank cheek becomes a disk, and wrought iron hoops bored and shrunk on and then turned and polished secure their counter-balances.

This is a double-acting, reciprocating engine, and has a speed of 900 to 1,000 revolutions per

minute, which necessitates very accurate balancing of the rotating parts, and perfect cushioning of the reciprocating parts, all of which are made as light as possible for this purpose.

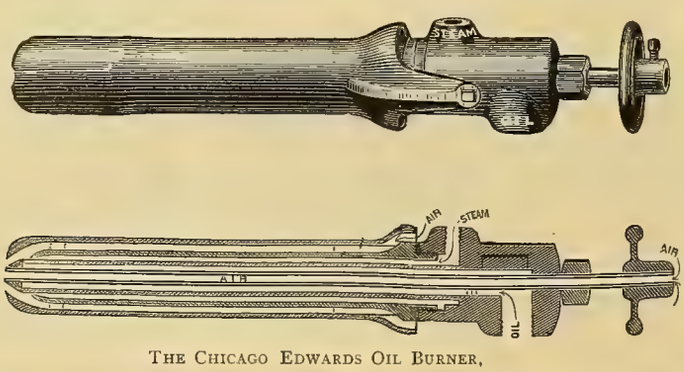
The eccentric which actuates the piston valve is also balanced and finally adjusted by experiment; and the piston valve itself is very light, and accurately ground into the liner forming its working seat. The governor is of the "Acme" type, fitted direct to the engine shaft, and actuates an equilibrium valve by a short bell-crank lever. The speed is adjusted by a speeding device.

The dynamo occupies about four-fifths of the space and the engine one-fifth, both being so combined as to form one complete machine.

One recently exhibited at the Anglo-American Brush company's exhibition at Manchester was a 4 horse power engine combined with a Victoria B2 compound wound dynamo, giving an output of 80 amperes, and 65 volts, and was connected with a motor and pump, and worked very satisfactorily.

The Chicago Edwards Oil Burner.

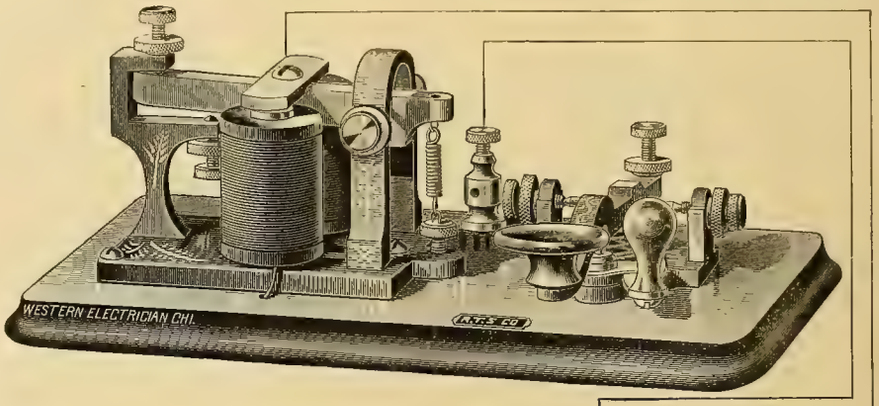
The matter of burning crude petroleum under steam boilers in electric light plants is brought to attention again by the cuts in connection showing the form of burner made by the Chicago Edwards Oil Burner & Manfg. Co., 81 Randolph street, Chicago. The upper cut shows the burner in perspective, and the lower in section. But little in explanation is required. The oil is fed by gravity from a tank, through a pipe which connects at the lower right hand part of the burner; the steam is taken from the dome of the boiler by a pipe which connects with the opening on the upper right hand part of the burner, while the air is admitted both through the cylindrical shell and through the spindle of the regulator, as shown. In using this burner it is customary to cover the grate bars with fire brick, excepting a space about eight inches square in front of each door for the admission of air; then to make a six-inch square hole on each side of the fire box near the door, to take in air through the grate bars from the ash pit into a flue built six inches square, back each side of furnace about 35 inches from end of burner, then across, the two flues meeting at center, then back to bridge wall and up within two inches of the bottom of the boiler, with the opening pointing to the rear. Fire brick checker work is built on top of the bridge wall to within one-half inch of the bottom of the boiler, and a brick floor is laid back of the bridge wall to the back end of the boiler, leaving a space between the floor and bottom of boiler of not less than eighteen inches; then across the furnace about two feet from the bridge wall an eighteen inch checker-work wall is built up to within one-half inch of the bottom of boiler—the checker holes being two inches at the top and three inches at the bottom, and finally an eight inch checker-work wall is built at the back end of the boiler.



The Chicago Edwards Oil Burner.

The Lima, O., Electric Light, Heat & Power company; the Lafayette, Ind., Electric Light company, and the Muskegon, Mich., Electric Light company are using burners of this description, with crude oil for fuel. The experience of the former company will be of interest. They write:

"The oil burners put into the boilers at the electric light plant have proved very satisfactory. For the past two months we have used 100 barrels of oil per week, running twenty-four hours per day, with two 80 horse power boilers developing with Buckeye engines, 50 horse power for 18 hours; and 100 horse power for 12 hours. They never give any trouble, and even at a higher cost than coal per horse power it would be economy to burn oil with the Chicago Edwards Burner. We have no cinders or dust, which is a great point with our business. We can produce with these engines and the oil burners 1 horse power with 1-6 gallon of oil per hour; or 2½ bbls. of oil equal to one ton of coal. We make a saving of at least one-half in our fuel."



A New Telegraph Learner's Instrument.

The Railway Telegraph Supply company, M. A. Knapp, manager, 213 Randolph street, Chicago, have placed on the market the new style of telegraph learner's instrument shown in the accompanying cut. The instrument is as handsome and useful as the cut which so graphically shows its details. It is the intention to sell the instrument with the battery and thus place each learner in a position to set up his instrument by himself and take the first step towards learning telegraphy.

The Telephone Trouble at Rochester, N.Y.

On the 13th the executive committee of the People's Telephone association of Rochester, N. Y., adopted the contract drawn up by the law committee in furtherence of the settlement of the trouble between the telephone company and its patrons. There were present: Dr. Jonas Jones, F. J. Amsden, John Van Voorhis, M. W. Cooke, George H. Newell, A. W. Mudge, Jas. S. Graham, L. P. Ross, B. H. Clark, C. A. Phillips, George Weldon, S. Remington, F. H. Vick, E. H. Davis, E. A. Chase.

The document, which bears the formidable title of "Memorandum of agreement and understanding between the People's Telephone association and its members and the Bell Telephone company of Buffalo," starts off, reiterating the resolutions adopted at the time the strike was inaugurated, which stated among other things that the subscribers would not use their instruments until the Bell company withdrew its order changing the flat rate to a toll rate and adopted a scale of rates acceptable to the association. The Bell company had proposed to abandon the toll system and acceded to other demands, the document continues, and as the company desires the People's association to rescind or suspend the resolutions passed over a year ago, as a condition of such suspension of the resolutions it is demanded that the Bell company pledge itself to the People's association and each of its members as follows:

First.—That it will make and complete such agreement and arrangements with the city of Rochester as may be required to protect the public interests in the premises, and, to this end, it will formally petition the common council, immediately, for its consent to the laying of its wires or conduits under ground in East and West Main streets, State street, and Front street, to the extent of at least three miles along said streets, and remove its poles and wires from said streets to said extent; that it will, upon the granting of such petition agree to and comply with such reasonable regulations and conditions as the city of Rochester may impose upon the granting of such petition; and that it will remove its poles and wires from the business streets aforesaid to the extent of three miles and place its wires underground the same distance within five years from the date hereof, and that at least one half-mile of such removals and underground work shall be done in the year 1888, and not less than one half mile in 1889; that the same regulations as exist in Boston, in so far as they are applicable and affect the use of the streets and public and private property by the use of the telephone companies, shall be made for the city of Rochester, and such other reasonable rules and regulations as the city of Rochester may impose in the premises.

Second.—That said company will immediately abandon the toll system of collecting its revenues and establish a flat rate for all its subscribers in Rochester, and will not directly nor indirectly impose any other system than that which is known as the flat rate system.

Third.—That said company will place its wires underground in the principal streets hereinbefore mentioned, or remove them from said streets to the extent aforesaid within said five years and to the extent hereinbefore mentioned, in 1888 and 1889, unless the city of Rochester, or other competent authority, shall require a more rapid removal of said poles or wires, in which case the said company pledges itself to comply with the requirements of the city of Rochester in this respect, and duly to obligate itself to this end, and to give such indemnity to the city of Rochester as it shall require to protect itself from liability for damages from any poles or wires, or structure of any kind, and from any operations of said company in said city, and to protect the city of Rochester from or for any damages, and if the city desire it, the company is to furnish, free of charge and expense to the city, for all time, such opportunity and space and fixtures as it may require upon the top cross-arms of any of the poles of the company in said city, and space and opportunity to operate and place to the extent of 100 wires—one duct—in all underground conduits.

Fourth.—Telephone subscribers who ceased using their instruments in November, 1886, and

who resume the relation of subscribers, or offer to do so, prior to March 1, 1888, shall receive credit for amounts paid by them for service to be rendered after November 20, 1886, and all claims by the company upon contracts with subscribers in force November 20, 1886, for moneys which became due, or for which they became liable, on or prior to November 20, 1886, for service after said date to the expiration of their contracts shall be cancelled, and such subscribers released from liability upon such contracts, and all subscribers liable on such contracts, November 20, 1886, shall be released from liability upon such contracts for telephone services.

Fifth.—In the suits of the company against George H. Worrall et al., the company is to stipulate to cause it to be discontinued and defendants released from liability, and the company is to pay the defendants' taxable costs and disbursements and reasonable counsel fees to the attorney and counsel of defendant in said case; and, subject to the consent and stipulation of the attorney general, the company is to stipulate discontinuance of the suit of the people against

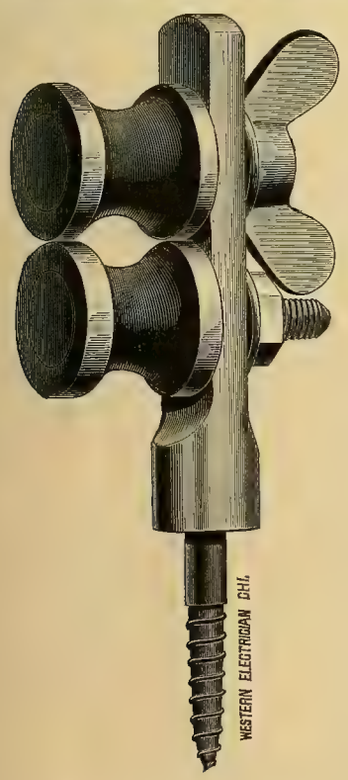


Fig. 1.—A New Carrier for Linemen.

the company, and to pay all costs and disbursements of the plaintiff and amounts due the attorney general, and also reasonable counsel fees to the counsel who appeared for or represent the plaintiffs in said action, and the company to pay the reasonable charges for the services and counsel of the members of the law committee of the association, in respect to the legal matters arising out of the contest between the subscribers and said company since October 1, 1886.

Sixth.—That the company will cause to be elected into its board of directors three residents of Rochester, to be selected by the executive committee of the association by a two-thirds vote of said committee. In case of a vacancy, others are to be selected in the same manner by said committee.

Seventh.—Said company agrees not to charge in excess of the following rates for the use of the telephones for night and day unlimited service, providing the best obtainable apparatus and facilities in every respect, viz: For business stations on special lines at the rate of $64 per year, and on combination lines at the rate of $57; for professional persons on special lines at the rate of $54, and on combination lines at the rate of $46; for residences on special lines, at the rate of $45; and on combination lines at the rate of $40; with mileage at the rate per mile of $20 per annum beyond one mile, except on combination lines, where each subscriber is entitled to one mile; subscribers to have special or combination lines at their option. The above mentioned rates not to be increased for five years, except when the company's wires are put underground. After the completion of each half-mile of underground work, not exceeding two miles, the rate of each subscriber may be increased fifty cents per annum. But in case said company is, during the said five years, relieved from the royalties now being paid to the parent company of Boston, or from any part thereof, or in case the American Bell telephone company, said parent company, or its successors shall at any time reduce the royalties charged to any other company or users of telephones in this state, either by compulsion or by its voluntary action, or if the rates for telephone service applicable to Rochester shall be reduced by the legislature, a corresponding reduction shall be made to said subscribers in the above mentioned rates.

Eighth.—In case any subscriber shall rent or take a second station on the same line, the price for the second station shall be at one half of the rates provided for herein.

Ninth.—In case the People's Telephone association shall rescind or suspend the said resolutions from operation for five years, the said company pledges itself to bind and obligate itself to carry out the terms and spirit of this undertaking and arrangement in such form as the law committee of the said association shall determine, either by inserting provisions in the telephone contract with subscribers, so that it shall be obligated to each subscriber, or by contract with the city of Rochester, or by both.

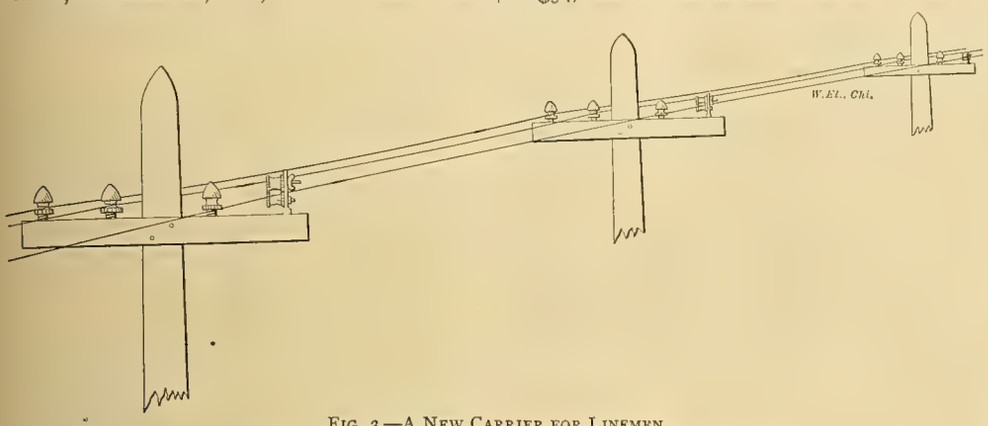


Fig. 3.—A New Carrier for Linemen.

A New Carrier for Linemen.

Linemen who have struggled with tangles, knots and crosses in telegraph and telephone wires, will recognize at once the utility of the simple little tool illustrated in the accompanying cuts, of which Fig. 1 is a full size perspective view, Fig. 2 an outline view showing the manipulation of the tool and Fig. 3 the method of using it.

The tool or carrier, as it is termed, was designed for stringing or taking down wires but it will prove particularly valuable in replacing old wires on telegraph poles with new wires, as where a large number of wires are strung on the same pole it is a difficult job to replace any or all of them, as they have to be cut at frequent intervals and involving tangles without number and resulting naturally in crosses. By the use of this tool long stretches of wire can be put up or taken down or replaced with new in a very expeditious and rapid way. The device as shown in Fig. 1, consists of a standard provided at the bottom with a gimlet-point screw. On axes at right angles to the standard are two sheaves between which the wire is designed to run. The upper sheave or roller, by means of the thumb-screw shown is adjustable and permits the roller to be so extended as to allow the insertion of the wire between the rollers. This is shown plainly in Fig. 2. When using the tool the lineman goes from pole to pole, screws a carrier into the cross arm next each glass insulator of the line to be renewed and detaching the wire places it between the two sheaves; the new wire is then attached to one end of the section of old wire and by pulling at the other end of the section the old wire is readily drawn out while at the same time the new wire is drawn into place. The lineman then ties the new wire to the insulators, removes his carriers which are then ready to be used on another section.

Wires can be taken down or strung in the same way, the chief point being the very great reduction of friction by the use of the carriers.

The Western Electric company, of Chicago, is preparing to introduce these useful tools to the trade.

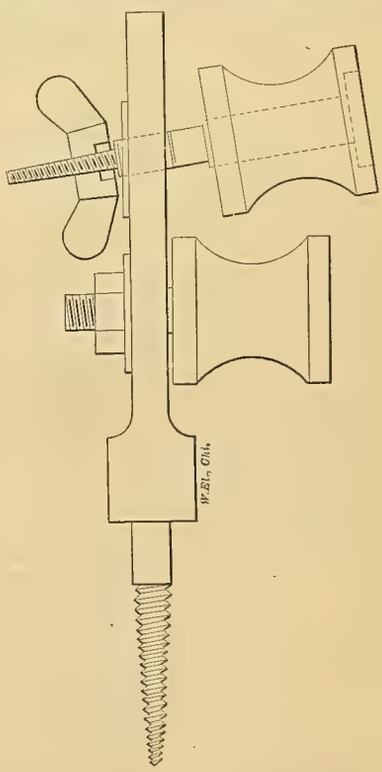


Fig. 2.—A New Carrier for Linemen.

A Government Telegraph.

Senator Cullom proposes to amend his telegraph bill, changing the rates named in the original bill, more especially for the transmission of press matter. While he believed congress ought to prescribe rates for the use of the government wires as it prescribes rates for the use of the mails, instead of leaving it to the discretion of officials, yet the rates named in his bill were designed merely as a suggestion to the committee which should have the bill in charge. He has reached the conclusion that there ought to be no difference upon government lines between service of like character rendered to evening papers and those to morning papers, and that the government should know no preferred patrons as to rates for like classes of business or as to order of transmission. The rates to be named in his amendment are based upon a unit of one hundred words or fraction thereof, and are as follows: For 500 miles or less, 25 cents; between 500 and 1,000 miles, 30 cents; between 1,000 and 1,500 miles, 35 cents; between 1,500 and 2,000 miles, 40 cents; between 2,000 and 3,000 miles, 45 cents, and for more than 3,000 miles, 50 cents. When more than one copy of the same dispatch is sent to the different newspapers at the same or at different offices the postmaster general is to prescribe the rates to be charged for the "drop" copies.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

NUMBER XXVI.

Arc Light Carbons.—As the efficiency of the electric light depends very largely on the carbons it is of the highest importance that they should be properly prepared; hence not only the materials of which they are composed, and the methods used in their preparation, require careful consideration, but their length, diameter, conductivity, resistance and other points, are also matters of the utmost importance in securing the best results.

As already stated wood charcoal was the substance employed by Sir Humphrey Davy, but this, in its ordinary state is unsuitable, being soft porous, and rapidly consumed, with a deflagration troublesome and dangerous; it therefore became necessary to find some form of carbon which would consume slowly, and give a steady, brilliant light. The carbon cut from the interior of gas retorts, was proposed by Foucault, and was found to fulfill these conditions to a certain extent, but its impurity and lack of homogeneousness interfered seriously with the quality and steadiness of the light, though, for want of something better, it was used in all the early experiments; but it became evident that carbons specially prepared for this purpose were required, and this requirement became the more imperative when electric lighting, by the invention of the dynamo, was made a commercial success. Various experiments by different European inventors finally resulted in the production in France of the carbons of Carré and Gaudoin, which were the first to fulfil approximately the required conditions of purity, homogeneity, proper resistance, and proper form.

Previous experiments in this direction by Lacassagne, Thiers and others had been made in 1857 and subsequently, by pulverizing and purifying the carbon, making it into a paste, molding and baking it. One of the early methods of Gaudoin was to use rods of wood charcoal, similar to those employed by Davy, infiltrate them with various hydrocarbons by repeated soaking and baking alternately till they had attained the necessary consistence as indicated by their metallic ring.

The Carré carbons, which still maintain a high standard of excellence, are now made as follows: Fifteen parts of pure coke finely pulverized, and five parts of calcined lampblack are mixed with seven to eight parts of a syrup made of cane sugar and gum arabic, in the proportions of thirty parts of sugar to ten parts of gum. The mixture is then pulverized, made into a paste with water, forced under heavy pressure into a die of the form required for the carbons, and baked repeatedly at a very high temperature. After each baking the carbons are immersed in a concentrated syrup of burnt sugar, maintained at a boiling temperature, so as to fill the pores with the sugar, the process being facilitated by intervals of cooling; and the superfluous syrup being washed from their surfaces with boiling water previous to each baking. When the required density is attained the carbons are slowly dried for about fifteen hours at a temperature of about 170°C. and are then ready for use. Great tenacity is one of the good qualities claimed for these carbons, and they can be used in lengths of twenty inches without risk of fracture.

The Gaudoin carbons are made from carbon obtained by the destructive distillation, in closed graphite crucibles, of tar, bitumen, pitch, oil and other substances; all foreign matter being expelled, leaving a residuum of nearly pure carbon.

This is reduced to a fine powder, made into a paste, and the carbons formed under a high pressure.

Napoli, another French manufacturer, makes his carbons from a coke obtained from the slow distillation of coal. This coke after being pulverized and screened is mixed with gas tar, in the proportion of 75 per cent. of the coke to 25 per cent. of the tar. The carbons, after being formed, are first baked at a low temperature, not exceeding that at which the coke and tar were produced; after cooling they are baked again at a white heat, which removes all traces of gas, producing carbons of great hardness, ready for use without further treatment, which are said to give a steady, pure, white light at a slow rate of consumption.

In the manufacture of the Liepmann carbons, made in London, the raw material is obtained from the distillation of mineral oil, which, it is claimed, contains only carbon and hydrocarbons, and furnishes carbons free from the impurities found in those made from coke, graphite, or retort carbon, which produce the colored tints and flickerings in the light, and the troublesome ash deposit. The material is soft and brittle, and easily pulverized. It is first ground to a fine powder, then baked, and subsequently mixed with a specially prepared tar, and the paste thus formed, molded into carbons. The molding is done under a pressure of about 13,000 pounds to the square inch, obtained from a hydraulic accumulator in connection with a steam engine and pump. The carbon rod, squirted endways through a die, issues continuously upon a table moved on rollers, and when a length of four feet is attained it is cut into 12 inch lengths by four knives carried in a frame. The carbons are then stacked with carbon dust between the layers to prevent adhesion, dried in the air for several weeks, and then straightened by being rolled between boards, after having been sufficiently heated to render them plastic. Two kinds are prepared in this way, the solid carbons and the shells for cored carbons. These shells are closed at one end and the cores injected by a small hydraulic press.

The baking, which is an exceedingly important and delicate operation, is done in gas heated furnaces in which the heat can be kept under perfect control. The carbons, stacked upon an iron trolly, are slowly passed through the principal furnace which has five zones of heat; they enter through the coolest zone and emerge through the hottest, and then pass into an auxiliary furnace the temperature of which is reduced very slowly. They are then finished by trimming the ends, and copper plating such as require it; and after being tested for resistance are ready for use.

The testing is accomplished by an automatic machine, electrically controlled, through which the carbons are passed; each one being momentarily inserted in a shunt to a solenoid. The required resistance of a carbon being about two-tenths of an ohm, if the resistance exceeds this, the carbon is held, carried forward, and dropped into the box of rejected carbons; but if the resistance is less, permitting a greater flow of current through the carbon, the current through the solenoid is reduced, and by means of a spring, which opposes the attraction of the solenoid, the carbon is released and drops into another box.

The copper plating is accomplished by an apparatus having eight sliding frames, each carrying a row of spring clips by which the carbons are suspended, and under each frame a glass vessel containing dilute sulphuric acid in which a copper cylinder is immersed; this cylinder forms one of the electrodes, and the frame, when lowered and immersed in the liquid, forms the other. The current is furnished by a dynamo which also supplies the current for the testing machine; connection being madeby an automatic switch when the frame is lowered; and the time required for plating is indicated by the color of the deposit.

In the United States the material now used in the manufacture of arc light carbons is petroleum coke, a residuum of the distillation of crude petroleum, which contains very little foreign matter that can not be expelled by heat. This is ground and mixed with some hydro-carbon, generally gas-house pitch, and the mixture then ground again. It is then placed in steel molds of the proper form, 12 inches long, and heated sufficiently to render it plastic, after which it is subjected to a hydraulic pressure of from 3,000 to 8,000 pounds to the square inch; the amount of pressure depending on the purpose for which the carbons are intended. They are then baked at a high temperature for 24 to 100 hours, according to the style of furnace, and number of carbons placed in it. The crooked carbons are then culled out and the straight ones electroplated.

The Lyons, Kan., electric light plant was put in operation January 11th.

Practical Telephony.

By Thos. D. Lockwood.

Part IV.

In describing the calling generator, I intimated that there was still another attachment to speak about, which would be referred to thereafter.

Let us look at Fig. 5. We see there a series of magnets; they are horse-shoe magnets, but not being privileged to see at the same time both sides of an opaque substance, we can only see one side of them. They are the generator magnets and between their poles lies and revolves the Siemens armature which was described in our last.

The armature is rotated by a spur wheel and pinion, or some equivalent mechanical device, the pinion being on the armature axis, and the wheel mounted upon an axle in a journal above, which is adapted to be rotated by a crank. [I mean a crank handle.] The whole indicates the generator and is marked with the letter *G*. The wire from one end of the armature coil passes to the line and out to the bell *b* at the distant station, where it finally terminates at the earth. The other end of the armature coil, by means of suitable springs or brushes, is in connection with an earth wire at the same station. The line wire, it will be noticed, is broken or discontinuous about the middle portion; this is merely to indicate that it may be of any length. Now as far as the ringing is concerned, the apparatus I have already described is sufficient, and the "bell can go ringing for Sarah" all day if necessary; but for several good reasons, two, at all events, it is found advisable to cut out of circuit the gener-

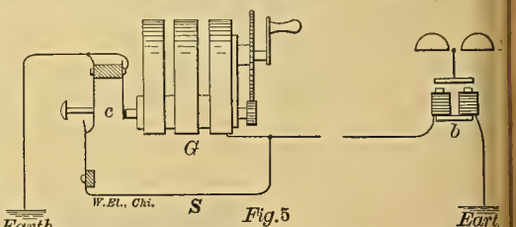


Fig. 5

ator coils whenever the act of ringing is not in operation.

The first reason is that it is always an advantage to keep the resistance of the circuit down to as low a point as possible. It would take a stronger generator than is at all necessary to ring the bell, if all the generators were always in circuit, because there is a considerable amount of fine wire on the armature, involving a high resistance, and except when the call is being sent, a useless resistance; and on a private line, for example, where there are, say, five stations to a mile of line wire, the resistance of five generators would be an important factor, and it would be almost impossible to make the bells ring loudly from any station. Again it is useless to expose any more fine silk-covered coil wire to the action of lightning and dynamo crosses, than is absolutely necessary. In the third place, if there are any intermediate stations on a line, the introduction of electro-magnets of any kind into the circuit deteriorates the loudness and clearness of the transmitted telephonic conversation more than anything else can, making it both weak and inarticulate; this is owing to magneto-electric currents which, whenever an electric change occurs in the coil, are generated usually in opposition to the legitimate talking current. The bell magnets exercise this adverse effect also, but it is clear that we can not cut these out, because they are what we must ring the subscriber with. Where there are way stations, several plans have been and may be adopted with respect to the bells to lessen the evil. The simplest way is to wind the magnets with coarser wire; another good way is to connect the bell magnets in multiple arc instead of in series, and by this means the resistance is reduced to one fourth of its original magnitude, while the adverse currents are also generated in much less force.

Well, this long explanation is only the prelude to the statement that the line seen below the magnets in the diagram, curling up at the right and touching the main line outside of the generator, and at its left terminating in a spring, which bears upon the end of another spring, is the shunt

wire or short-circuiter of the armature. The second spring is in electrical contact with the armature brush. The crank may be turned rapidly while this shunt circuit is unbroken but no electricity passes to line, and no bell is rung; the only thing that can happen is that the electricity generated within the short-circuited coils may take a run cross-lots, and break through the silk insulation, damaging the generator.

The little push button at the left of the figure controls the shunt; when it is pushed, the springs are separated, the short circuit is broken, the electricity flows to line, and the distant bell is rung.

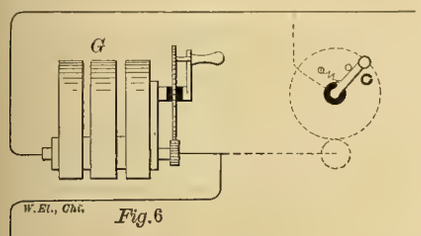


Fig. 6

For a long time this manually operated push button was the only means for controlling the shunt. By and by the American rage for labor-saving devices broke out, and an automatic shunt-breaking device was adopted. Pretty nearly about the same time some half-dozen different arrangements were invented for this purpose by as many different great inventors; and out of them all I have picked the one shown in Fig. 6, not because it is so much better than any other, but because it is easier to show in a picture. Even now, to make the matter as clear as I hope to, I have had to show two views in one drawing of the wheel and pinion of the driving gear.

That view which is seen at the right in dotted lines, is merely a phantom, thrown in to indicate the electrical connections. In fact, the electrical arrangement is exactly the same as in the first case; the generator coil is in two circuits at once, a long one, viz: the line; and a short one, viz: the shunt; and as electricity although energetic, is characteristically lazy, the result is that as long as it has the choice of two ways, it will inevitably choose, or at least the greater part of it will choose the shortest. The difference between the two plans is that, whereas in the former, two hands were required, one to turn the crank and one to push the button, in the second plan the act of turning the crank, is caused automatically to break the short circuit.

The short circuit extends from one side of the generator to the metal of the mechanism, and thus to the pinion and wheel; and from a point on the main circuit on the other side of the generator to an arm on the crank shaft which is insulated. A coiled spring is fastened at one end to this arm, and at the other end to a fixed pin on the wheel. The crank shaft in this form works loose in the wheel.

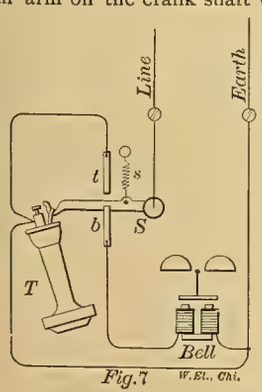


Fig. 7

When the generator is at rest, the short circuit is closed through the crank arm, and the pin against which it rests. When the crank is turned, the arm is pulled against the force of the spring away from the pin, thus breaking the short circuit, and the rotation continuing, it brings up against a second pin fixed also in the side of the wheel but insulated by a hard rubber bushing, and pressing against this, turns the wheel round.

As I have already said, this is only one type of the automatic arrangement, and perhaps not the best, but when the function, the "why" and "wherefore" is known, and when it is stated that this is the same in each case, and that the differences are only in mechanical detail, I am sure that this explanation is sufficient.

There is still another appliance in the bell box. This is the device which is at once the telephone support and an automatic switch. It is indicated in diagram in Fig. 7. We don't want to have to telephone through the bell magnet, and it is equally undesirable to have the telephone in circuit when the line is not in use. The reasons are substantially the same, as have been already detailed in speaking of the generator. Consequently almost as soon as the telephone was used, the utility of *some* switch was seen. At first an ordinary manual, or button switch was employed, but the user, with persevering perversity, soon developed a stern and martyr-like resolution to leave the switch on the wrong side. Then a device was arranged so that the handle of the switch, when turned to the telephone side, stood opposite the telephone hook, and in such a position that the telephone could not be hung up until the switch was moved back to the bell side. This worked very well, but very naturally suggested in short order a further improvement, namely, an advance to the principle embodied in the drawing. In this advance the switch itself is turned into a lever which is pivoted at one end, and which has a yoke at the other end, so that the telephone when not in use can be hung there. A spiral retracting spring is then added to pull the switch in the opposite direction when the weight of the receiving telephone is removed. Now all we have to do is to make the switch lever of conducting material, and provide it with an electric contact piece at both upper and lower position. The line wire is permanently united to the switch lever. Both upper and lower switch contacts are in the form of flat springs. Obviously, the lower one must lead to the bell magnet because it is the bell which must be in circuit while the telephone is on the hook, and the line unused; and it is equally obvious that the upper spring must connect with a circuit leading through the telephone, because when we begin to use the latter we want to connect with the line, and we also want the bell disconnected. An inspection of the sketch Fig. 7, will show that these conditions are complied with. The line comes in, is attached to the hook lever *S;* this when the telephone is in place, is by its weight pressed down, and makes contact with the surface of the contact spring *b*, which has a wire, leading to one terminal of the bell magnet; the other wire of the bell is connected with the earth wire, or with the line out. But take the telephone from its place; now, the hook drawn by the spring *s* flies up, and makes contact with the flat spring *t*, leading to and through the telephone and to earth, or to the wire out; and at the same time entirely disconnecting the bell. Many varieties of this arrangement have from time to time been in use, but all embody the same principle.

As long as the magneto telephone only was used, the above switch was all that was necessary. But in process of time the battery transmitter came into use; this necessitated the introduction first of all of a battery. Now, a new problem faced the telephone constructor. The battery was only wanted occasionally; the LeClanché battery or some other open circuit battery was the most convenient, but if its circuit was kept closed for many minutes in succession it became polarized, and lost its power.

So one of two things had to be done. Either provide a closed circuit battery, like the Daniell or gravity types, or some automatic contrivance by which the circuit of a LeClanché battery could be opened when not in use, and closed through the transmitter when wanted. Gravity batteries at their best are what the late Mr. Mantalini would have called "dem'd moist, unpleasant bodies," and besides being dirty, require considerable attention. The latter alternative was therefore adopted; and the arrangement is indicated in the sketch Fig. 8.

Two other contact springs are added on the upper side of the switch, which form the two ordinarily disconnected terminals of the local, or transmitter battery. Now the regular main line circuits are the same as before, the bell branch leading from the spring *b* through the bell to earth; the telephone circuit from the switch leads from spring *t* by wire 3 to and through the secondary circuit of the transmitter induction coil, and then through the hand telephone to the screw leading to earth or line out; we will now trace the battery circuit; this, leaving the battery *B* and tracing downward, passes by wire 1 to the primary circuit of the transmitter coil; from the other end of the said coil to one of the transmitter contacts, then to the other or opposing contact and out by wire 2 to one of the additional springs *s*, at the switch, through the metal of the switch to the second spring *s*, and from there back to the opposite pole of the battery.

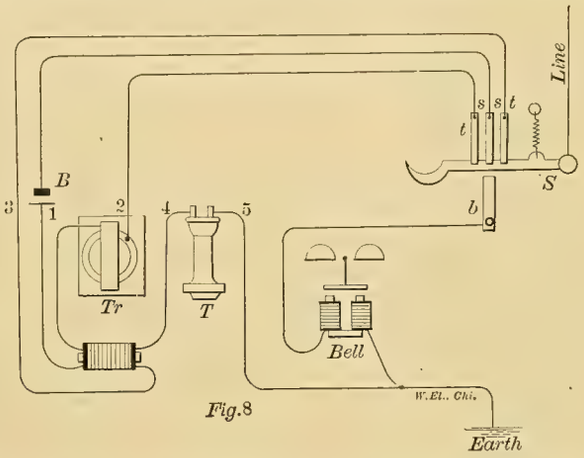


Fig. 8

It will be noticed that at the switch the mai and local circuits are actually in contact with on another, but this does no harm provided they do not touch at any other point. If they do, so much of the local circuit as lies between the two points is cut out.

Quite frequently, the switch is made with but two contact springs for the upper position, one of them having to serve both as main line telephone and local spring, but I think it tends to simplicity to have three, and also that it is better if it can be done, to have an insulated contact plate for the two local contact springs to press on, so that no cross can take place between the two circuits.

This is only, however, for additional security. In Part V. I propose to discuss the several ailments which attack the appliances I have here described.

(*To be continued.*)

In the London *Electrician* of Dec. 9th, C. F. Proctor claims that the phenomenon of semi-decomposition of lead glass in lamps by electric current aided by heat, described by Mr. Cherrill, in the article reproduced in this journal. was pointed out by him and proved by C. H. Stearn, to be electrolytic action two years ago, when he (Proctor) was sub-manager under Mr. Cherrill. In the correspondence given Mr. Stearn credits the discovery of the electrolytic action to Mr Proctor and says: "I have embedded flat plates of platinum in a block of the glass and produced the blackening in less than a minute, the glass being very hot. I reversed the current and got the second pole black." He adds that in every instance gas was evolved at one pole while the blackening occurred at the other pole, causing bubbles in the glass, with consequent leakage and bad vacua.

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THE semi-annual convention of Edison companies will be held in Chicago the second Wednesday in February.

THE headquarters of the WESTERN ELECTRICIAN, during the electric light convention February 21st, 22d and 23d, at Pittsburgh, will be in parlor 10 of the Monongahela house.

MR. BROWN'S paper, read before the Chicago Electric club last Monday evening, taking grounds against the proposed revision of the patent law, will commend itself as a clear and able exposition of reasons why revision of patent laws and methods should not be undertaken at this time during the discussion of this important question, the paper should, and undoubtedly will, receive careful perusal and consideration.

AN interesting document is that bearing the title of "memorandum of agreement and understanding between the People's Telephone association [of Rochester, N. Y.,] and the Bell Telephone company, of Buffalo," reproduced in our columns this week. The agreement states in plain language the conditions on which the American Bell Telephone company can resume business in Rochester, and it is believed, if the spirit shown by the ex-telephone users of that city is a criterion, that the American Bell will have to accede to the conditions or let the plant of the sub-company in Rochester lie idle a while longer.

AT the meeting of the Chicago city council Monday evening last Corporation-counsel Green presented an opinion regarding a proposed ordinance licensing telephones. He maintained as he has heretofore that the city could not exact a license fee for each instrument in use.

On the question of the right the Chicago telephone company had in the streets, he was of the opinion that the company had never obtained the consent of the city to its use of the city's thoroughfares. The company had acquired the property of the Bell Telephone company, but had not obtained the franchise to occupy the streets by the transfer. The law required the company to obtain the city's consent to the occupancy of its streets, and, having failed to obtain it, the corporation had no rights in them.

An ordinance was then submitted, emanating, it is understood, from the Chicago Telephone company, providing for a payment of a license fee of five dollars for each telephone and dividing the streets into two classes, one including those in which wires should be laid undergound and the other those in which wires should be strung aerially. The ordinance was ordered printed.

THE phase put upon telephone litigation in the state of Indiana by the decision of Judge Ventor in the matter of the application of Susan B. Tulley for a mandate compelling the Central Union Telephone company to supply her a telephone and connections at the rate established by the legislature—three dollars per month—noted in a recent number of the WESTERN ELECTRICIAN, has attracted considerable attention. Heretofore the telephone company has assumed that it had the option of accepting or refusing the rate fixed by the legislature, but in spite of the company's arguments the judge held that as the company was engaged in a general telephone business it was bound to supply telephones and connections at the rate fixed by law.

PROFESSOR BARRETT, city electrician of Chicago, submitted an estimate to the city council, January 3rd, on the cost of erecting a city electric light plant on three different systems. The cost of a central station incandescent system with a capacity equal to an average constant demand of 75,000 lamps of 16 candle power each, averaging 840,000 lamp hours per day, he estimated at $1,950,000 exclusive of real estate; of a municipal incandescent system including building for station $541,698; of an arc light system for street lighting only $435,230. In notable contrast to these figures are those of George B. Swift, commissioner of public works of Chicago, on the cost of a gas plant for furnishing gas to private consumers as well as for street lighting, presented at the Monday night's meeting of the city council of Chicago, based upon the cost of the gas plant owned and operated by the city of Philadelphia. The plant there consists of four manufacturing stations and five holders. The works have a daily manufacturing capacity of 14,000,000 cubic feet with a storage capacity of 12,000,000. The daily output of the Chicago gas companies is between 13,000,000 and 14,000,000. The entire cost of the Philadelphia plant, after deducting earnings up to date, was $8,125,000, of this amount $750,000 was paid for gas works belonging to corporations in suburban towns. The price of gas is $1.50 a thousand cubic feet. In 1885 it was $1.70 and in 1886 $1.60. The estimated value of the works, not including real estate, is $12,883,047.58. The commissioner estimated that a plant can be erected in Chicago, exclusive of real estate, capable of an output equal to that of to-day, for $6,000,000.

THE supreme court of the state of Louisiana on the 9th inst. handed down a decision in the case of the city of New Orleans *vs.* the Great Southern Telephone & Telegraph company. A syllabus of the decision is appended. From it the points in controversy can be gathered. A perusal will impress the reader with the fact that the decision is eminently just and in accordance with equity. The decision reads:

"1. An annual charge of $5 per pole upon the poles of a telephone company already established, imposed by a municipal ordinance as a 'consideration for the privilege' is not a tax either on property or as a license, and can not be sustained as an exercise of the taxing power.

"2. It is not an exercise of the police power, as it involves no consideration of public order, health, morals or convenience.

"3. A municipal ordinance granting to a particular company authority to construct and maintain telephone lines on the streets, without any limitation as to time and for a consideration stipulated, when accepted and acted on by the grantee by a compliance with all its conditions and the construction of a valuable and expensive plant, acquires thereby the features of a contract which the city can not thereafter abolish or alter in its essential terms without the consent of the grantee; and the imposition of new and burdensome considerations is a violation thereof.

"4. A provision in the ordinance to the effect that 'the acts and doings of the company under the ordinance shall be subject to any ordinance or ordinances that may be hereafter passed by the city'—does not convert the grant into a mere revocable permit. On the contrary, it assumes that the ordinance is to continue in full force and effect and recognizes the right of the grantee to do and to act under and in accordance with it and only subjects 'such acts and doings' to future municipal regulations not inconsistant with the ordinance itself.

"Judgment affirmed."

THE executive committee of the National Electric Light association met in Baltimore on the 7th inst., preparatory to the seventh semi-annual convention to be held at the Monongahela House in Pittsburgh, Feby. 21st, 22nd and 23rd. The committee investigated the financial affairs of the association, and found them in satisfactory condition; and decided that the association would insist upon the just revision of the patent laws. The subject of the formation of a coöperative carbon company by the various electric light companies of the country, numbering about 300, was discussed. The secretary was directed to correspond with the leading manufacturers of carbons in the country requesting them to present their views at the meeting of the association.

J. Frank Morrison positively declined re-nomination to the presidency of the association, and a sub-committee was appointed to recommend the name of his successor.

The programme of the papers to be presented at the convention is appended. Its range is wide and as might be inferred the topics to be introduced for discussion are live ones and of interest to every man engaged in electric lighting or the development of power through the medium of electricity:

A. L. Reinman, of Westinghouse Electric company, "Incandescent lamps."

C. O. Mailloux, of Julien Electric company, "Storage batteries."

F. J. Sprague, of the Sprague Motor company "Dollar and cent question of the motor business."

P. O. Keilholtz, of United States Electric Illuminating company, Baltimore, Md., "Fuel gas and storage batteries.

G. A. Leibig, of Baxter Motor company, "Motors in general."

W. W. Leggett and Jesse M. Smith, "Underground conduits for arc lights."

T. C. Smith, of Allegheny Co. Light company, Pittsburgh, Pa, "The practical side of the distribution of the alternating current from central stations."

Professor Thomson, of Thomson-Houston company, "Necessary tests for arc and incandescent mains."

O. B. Shallenberger, electrician Westinghouse Electric company, "The life of incandescent lamps and the general principle governing the distribution from alternating currents."

Professor Lange, Westinghouse Electric company, "The magnetic effect of currents upon various metals."

The Subway commission of New York have been invited to be present at the convention and express their views as to the feasibility, practicability and success of underground conduits from their observation in New York. Like commissions in Brooklyn and Philadelphia have also been invited to be present, and if they can not attend are requested to send experts.

The railroad fare from Chicago to Pittsburgh for persons attending the meeting will be $16, of which $12 will be paid on purchasing the ticket in Chicago, and $4 on purchasing the return ticket in Pittsburgh. It will be necessary for persons purchasing tickets to secure a certificate from the agent of whom they buy. This certificate must be presented to the secretary of the National Electric Light association, W. H. Harding. On presentation he will issue to the holder a certificate which will entitle him to a return trip to Chicago for $4.

The rate for the round trip is equal to one and one-third fares, and holds good throughout the west, including St. Paul, Minneapolis, Kansas City, St. Joseph, Denver, St. Louis, Cincinnati, Columbus, Indianapolis, Louisville, Detroit, Cleveland, etc.

Geo. S. Bowen, of Elgin, Ill., who is in charge of arrangements for the transportation of western members to the convention, will shortly issue a circular setting forth the details, but he is desirous that all persons intending to go to the convention advise him at once, in order that he may arrange that all who go from Chicago go on the same train.

Revision of the Patent Law.[1]

By C. A. Brown.

The business in which most of us are engaged, viz., that allied in some way to the manufacture and introduction of electrical apparatus, touches the law at many points. First, there is the patent law which prohibits the manufacture, sale or use of apparatus infringing on the monopoly given by the government to the patentee of anything new and useful. Then after you have made something which you are willing to guarantee is no infringement on any man's patent—no matter what some competitor may say—you meet, besides the laws relating to contracts, the more complicated questions regarding the powers of city authorities, perhaps, and last of all when you have made your apparatus, secured your contract in the proper form, and installed your plant, you meet the laws framed, so it is said, to enable people to avoid paying their just debts. We shall surely not go amiss then, if for one evening we turn from the consideration of mechanical electrical contrivances to discuss interests less physical in their character.

The subject which will be briefly presented in this paper is the patent law and its proposed amendment. Special interest attaches to this subject just now, as you are all aware, because an effort is being made, backed by the authority of the National Electric Light association to have a patent commission established. At the approaching electric light convention an effort will doubtless be made to take some final action in this matter, and it is in part with the view of having such of our members as shall attend this convention prepared to take intelligent action on this question that this paper on this subject is presented.

The bill which will be introduced into the fiftieth congress and to assist in securing the passage of which we have all been or will be asked to contribute, is as follows:

A BILL CREATING A COMMISSION TO EXAMINE AND REPORT TO CONGRESS NEEDFUL REFORMS IN THE PATENT LAW.

"*Whereas*, The patent laws of the United States are deemed to be in such condition as to require revision; therefore,

"*Be it enacted*, by the senate and house of representatives of the United States in congress assembled:

"Section 1. That a commission be, and the same is hereby created, to consist of three suitable persons to be appointed by the president of the United States, who shall hold office until a final report of this commission is submitted to and accepted by congress, and who shall receive for their service a compensation of $5,000 each per annum.

"Section 2. It shall be the duty of this commission to examine thoroughly the patent laws of the United States, and those of other countries, and their practical operation and effect, in meeting the needs of the public and fulfilling the purposes for which they were created; to formulate a report to be submitted to congress which shall set forth the results of this investigation and their conclusions therefrom, with reference to changes in, or additions to, the present law pertaining to patents. The report shall also contain a draft of an act which will provide for the changes found necessary by the investigations of the commission.

"Section 3. The commission is authorized to employ such clerical force as may be necessary for the proper conduct of its work and to incur such other expenses for stationery, printing, etc., as may be found expedient

"Section 4. The salaries of the members of this commission as well as all expenses legitimately incident to its work, shall be paid from the surplus in the United States treasury to the credit of the patent office. All expenditures by or for said commission, other than the salaries of the members, shall, however, be under the control of and authorized by the secretary of the interior."

When this bill is introduced into the fiftieth congress is it not likely that some congressman will ask, "If some one knows that the patent law needs revision why doesn't he point out in what respect the revision is necessary?" If this congressman should be "a terrible granger from the west," to use an expression of Mr. Walker in his speech at a recent meeting of the American Institute of Electrical Engineers, will he not go on and exclaim, "Fifteen thousand dollars a year and expenses to investigate the English and French, the German and Russian, the Swiss and Dutch patent laws and their practical operation!" [We are all aware that patent laws in Switzerland and Holland are like snakes in Ireland—there aren't any.] He will ask further, "Why can't we use the investigations which have already been made and the reports which have already been rendered about the foreign patent systems? Such reports are found in numerous books." And then he may assert that this commission scheme is a device of protectionists to reduce the surplus without reducing the tariff, and thus will be blighted the hope of those who favor this bill on the ground that it will allay the suspicions of congress as to the ulterior motives of its promotors. It may seem to some misguided granger that the advocacy of a bill proposing three $5,000-a-year jobs is in itself proof of an ulterior motive.

There is no dispute as to the advisability of a revision of the patent law in some respects. Mr. Steuart and others have pointed out numerous features which require change. Some of the faults that are found with the law are rather fanciful, but whatever they are can anyone say that it would be more difficult to have them remedied by applying directly to congress than it would be for instance, to secure the enactment of the proposed law creating a commission? And then we have to take the risk of the commission not being able to accomplish any good, and the possibility that the commission may consist of men who will do the patent law more harm than good.

Without claiming that we have "nothing to do with abroad," with entire willingness to learn whatever may be learned from foreign patent systems, and with due acknowledgment of the fact that the patent law of the United States is the offspring of the system of Great Britain, we can justly claim that our patent system is superior to that of any other country, both theoretically and practically, and a glance at the history of our patent law will show that it is not impossible, even without the aid of a commission, to amend it as occasion requires.

The constitutional provision for patents is contained in Article I, Section 8, of the fundamental law of the nation: "The congress shall have power to promote the progress of science and the useful arts by securing for limited times, to authors and inventors, the exclusive right to their respective writings and discoveries."

The first patent law, which was approved April 10, 1790, and has been amended and changed many times since without radical departure from the system originally founded, prescribed a petition to the secretary of state, the secretary of war and the attorney general and demanded a fee of five dollars. February 21, 1793, the act of 1790 was repealed and a new one was passed permitting the merger of existing state grants in regular national patents, and raising the fee to thirty dollars. By act of July 4, 1836, the patent office and the office of commissioner of patents were created; patents ran for fourteen years, conditionally extensible for seven more; provisions was made for examination into the novelty of the alleged invention; the fee for citizens was kept at thirty dollars with a drawback of twenty dollars if the patent was not allowed. The act of August 29, 1842, made designs patentable. The act of March 2, 1861, abolished extensions and made the term of patents seventeen years; the application fee was made fifteen dollars, and the final fee twenty dollars. Later acts are substantially codifications of the act of 1861, as modified by the construction which courts have put upon it.

In the discussion, at a recent meeting of the American Institute of Electrical Engineers in New York, of the question of the expediency of agitating patent law revision now in view of the hostility to the patent system which might be brought into active exercise, Mr. Phelps gave expression to the foreboding that an effort might be made to sweep away the entire patent system. George Ticknor Curtis asked if it would not be necessary to strike out part of the constitution to reach that? Mr. Phelps very cleverly and acutely replied by asking Mr. Curtis if the provision in the constitution were not that congress *may*.

This question of Mr. Phelps brings out very clearly a point that is worthy of careful attention, viz., the reason, as presented in the language of the constitution, why patents are granted. These reasons are not the ones that popular understanding supposes them to be. The belief is general that inventors have a natural right to the exclusive use of their inventions, and that the chief end and aim of the law is to give reward to the inventors. Such is not the case; an inventor has no natural right to the exclusive use of his invention. As a learned judge has said: "An inventor has no right to his invention at common law. He has no right of property in it originally. The right he derives is a creature of the statute and of grant, and is subject to certain conditions incorporated in the statutes and in the grants. If to-day you should invent an art, a process or a machine, you have no right at common law, nor any absolute natural right, to that for seven, ten, fourteen, or any given number of years against him who invents it to-morrow, without any knowledge of your invention, and thus cuts me and everybody else off from the right to do to-morrow what you have done to-day. There is no absolute or natural right at common law, that I, being the original and first inventor to-day, have to prevent you and everybody else from inventing and using to-morrow or next day the same thing.

"If an inventor has a natural exclusive right for his invention for one moment, he has it forever; and if any limit of time can be set to such a right, only infinite wisdom is adequate to the task. To state the doctrine of natural right thus is to show that it does not exist. The law has never recognized the doctrine of natural right for it can not recognize what does not exist.

"The constitution of these United States gives congress power to enact laws for a definite purpose, which is "to promote the progress of science and the useful arts," and the means to be used are, "by securing for limited terms to authors and inventors the exclusive right to their respective writings and discoveries."

The reason for enacting patent statutes is clearly stated in the fundamental law, but I submit that there is nothing in this fundamental law that renders it imperative on congress to enact patent statutes, or to prevent congress from sweeping away at once, constitutionally, all patent statutes that have been enacted. The safeguards of the present system are its wisdom and beneficent results.

It is estimated that at present one-half of the important inventions the world over, originate in the United States. The records of our patent office are sought for and studied by the inventors and scientists of every nation, and the wisdom of our advanced policy is almost universally admitted by men of the best intelligence. Sir William Thomson said in 1876, "if Europe does not amend its patent laws, America will speedily become the nursery of important inventions for the world."

Generally speaking, foreign patent systems differ from the American in not requiring an exhaustive preliminary examination of the invention as to novelty and utility before issuing the patent, in collecting annual taxes on patents and in requiring the invention to be worked within a given period.

I have gone briefly and cursorily into the history and policy of our patent system to show that it is the product of wisdom, and the result of mature and deliberate consideration. It can be improved, but not by any ill-considered action, and it is to be hoped that wise counsel will prevail when this subject is under consideration by the National Electric Light association. Some of the reasons why the proposed bill should not receive the final sanction of that body are:

First.—The unnecessary risk of having a commission which may be composed of men ignorant of or inimical to the present patent system.

Second.—The questionable policy of agitating patent law reform at this time when there is undoubtedly a good deal of hostility to the patent system on account of the driven well patent, the barb wire fence patent, and other patents.

[1] Read before the Chicago Electric club, January 16th.

Third.—The difficulty of getting the question of patent law reform properly considered during the term of congress just preceding a national election.

Fourth.—The questionable policy of going indirectly about accomplishing the reforms which are desirable, instead of appealing directly to congress to pass such amendments as are agreed upon as necessary and proper.

Fifth.—The advisability of getting a better general knowledge among those interested, of the present system, its merits and defects, before asking that they take action in amending the system.

Sixth.—The fact that many of the wisest and most thoughtful of patent lawyers and others well versed in the patent law and its operations, are opposed to the presentation of the bill referred to. I hold that no action of this sort should be taken without practical unanimity of the members of the body which is asked to give its authority and influence to the measure.

Previous to the reading of the paper the usual routine business of the club was transacted. The secretary announced that since the previous meeting seventeen new members had been elected and ten applications for membership had been received.

After the presentation of the paper Mr. Haskins was called to the chair and on motion of Mr. Kreidler a hearty vote of thanks was tendered Mr. Brown for the paper.

Mr. Haskins called upon George P. Barton for an expression of his opinion concerning the subject.

Mr. Barton: I do not agree with Mr. Brown as the natural right of one in an invention. He who makes an invention should, as a matter of right, be entitled to something for it. One who devotes himself to making improvements should not go empty-handed. It is right that he should have adequate remuneration. It is well settled, of course, that the common law gives no one any exclusive right in an invention. One who makes an invention, Mr. Brown seems to consider, is entitled to only what the government in its generosity gives him. In the opening of Mr. Brown's paper I noticed that he used the phrase "monopoly granted by the government"—just as if the government had given an inventor something. I repudiate the whole doctrine of gratuity in the grant. A man raises a bushel of wheat on his own farm and everyone says it is his. I don't know as anyone disputes that, and I don't know why the natural right does not apply equally in the case of a patent right. There is a different kind of right in a bushel of wheat—not but what it can be bought and sold the same—but it is a different species of property and therefore must be protected in a different way and consequently special statutes are enacted to protect it. If I could in any way make people generally understand that a patent right is property, that it is just as sacred as any other property, I think it would be a mission that I could heartily undertake. But it is a fact that people think it is not stealing to infringe a patent if they can do it without being caught; that is the general feeling and it is right on this subject that the public should be educated. We should then have a better regard for the patent law and for the patent system.

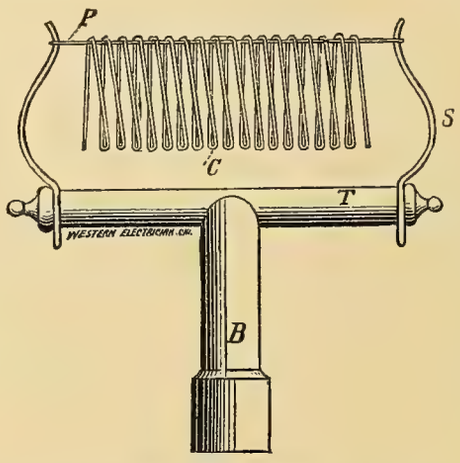
I don't care to speak about the specific reforms that have been proposed. I have given this subject a good deal of thought, and I will confess that I question the propriety of nearly everything that has been proposed in the recent discussions that I have heard and read. There are two or three simple amendments that all agree would be advantageous. I do not see how there is any substantial good or substantial improvement in the patent law to be gained by creating a commission. As has been stated, the creation of a commission is going indirectly instead of directly to the point. To create a commission would be to postpone for a year or two what should be done at once.

Mr. Brown, with regard to the question of a natural right in an invention, repeated the decision of the judge quoted in his paper, and said the law does not recognize any natural right. "I do not think any particular language can be found in the statutes that indicates that the law recognizes any natural right in an invention; the right to the patent after it has been granted is another thing. There are countries, Switzerland, and Holland, that do not have any patent law whatever."

Mr. Andrews inquired whether it was possible for a government to refuse a patent after the inventor has proved the invention was new and novel, and whether it was possible for a government to refuse to recognize the inalienable right of the inventor to his invention.

Mr. Brown replied that under the present statutes an inventor certainly has a right to his patent.

Mr. Andrews rejoined that when a man buys a piece of land and fails to secure a deed of it, he has no right to the land until he does, and asked if a man invents something and does not get it patented, if he has a natural or inalienable right to his invention?



The Lungren Burner.

Mr. Shain inquired if the fact that the government charges a fee when an inventor presents an application for a patent, and demands an additional fee when a patent is granted, does not constitute a contract in which an inalienable right of the inventor in his invention is recognized.

Mr. Haskins said that the decision of the judge was that no man has an inalienable right to an invention under our laws, but he has a right to the patent granted by those laws.

Mr. Shain: In some foreign countries do they not offer premiums for inventions? In this country no premium is offered, and a man obtains his profit from the sale of his invention.

Mr. Kempt: I think the points Mr. Brown makes are well taken. We are asked to meet very soon and take action on this matter, and the indications are that efforts will be made to petition congress to appoint a commission to revise the patent laws. The question is, is the position taken by Mr. Brown a wise one? Is it wise to indorse that position as electric light people? I agree with Mr. Brown that it is unwise for the proposed act to be passed by congress. I think the less we have to do with the changing of our patent laws the better. We all know that the patent law as applied to our business, is a very mixed-up affair. One able judge will decide one way, and another equally able judge will decide another way, and that, too, under the same law. The more we meddle with the law, the more we mix it up. I think that the reforms in the patent law should be in the preparation of the patents themselves. The wording should not be ambiguous. If we had a commissioner who could express the rights granted an inventor under a patent in plain, simple English that a child could understand, the better it would be for us.

Mr. Shain: I would like to ask whether the electric light people are the only agitators in this matter?

Mr. Barton: As long as ten years ago a compilation of arguments upon the revision of the patent laws was placed in my hands. Attorneys appeared before committees of both houses of congress, and they represented almost every industry in the country. It was one of the most general movements in favor of the revision of the patent law there has ever been. I was told at the time that there was no use of anyone paying any attention to the patent law now; the laws were going to be abolished, and, moreover, most of the inventions had already been made, and it was a bad time to begin the practice of patent law. I do not know of any class of business that is so much interested in the patent law as the electrical business, but I think you would find that if you got any kind of a bill before congress, other industries would be represented as advocates or opponents.

Mr. Horne: I would like to ask Mr. Brown whether the large number of patents granted by the United States government over any other country, is due to the genius of our inventors or to the protection given by the government under its patent laws?

Mr. Brown: That is similar to the question whether great men make great events or whether great events make great men. I think they react on each other. I think that protection has stimulated invention, but, at the same time, I would not say that we are not the greatest inventors of the world.

Incandescent Gas Light Systems.

The incandescent gas light is a subject that is claiming much attention in the gas world at present, and one that, from its very nature, possesses much interest to electric light men. Hence we commend to the attention of the electric light fraternity the brief description appended of several of the better known incandescent gas light systems:

The Welsbach Incandescent Gas Light.—This light was seen at the office of the local company of that name, at 67 Washington street, by a Western Electrician representative. The light has been mentioned heretofore in these columns, and, consequently, the description may be confined to narrow limits. Briefly, the incandescent burner is a cone of cotton which has been treated to solutions of different metals and then subjected to a heat sufficient to burn away the

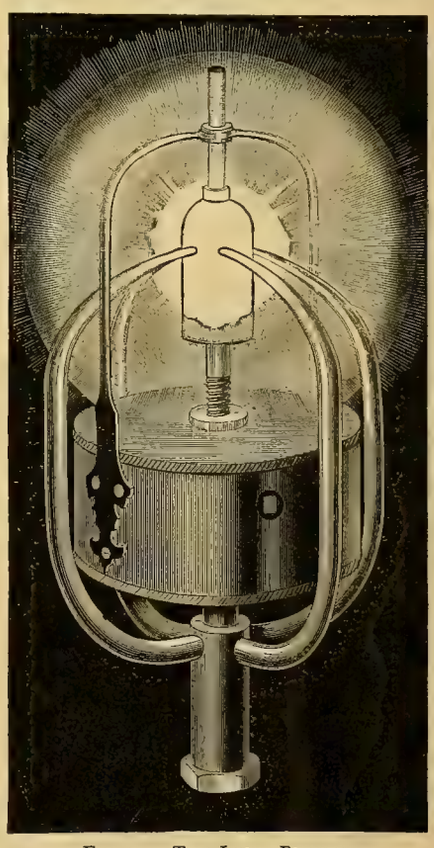


Fig. 1.—The Lowe Burner.

vegetable fiber, but which retains its form. The light, when seen by the representative of this paper, was burning on both illuminating gas and fuel gas. The latter, from its greater heating power, produced more illumination through the agency of the incandescent cone, the ratio being about three to one. A comparison by the photometer of a jet of illuminating gas without the incandescent burner and a jet of fuel gas with an incandescent burner, together with meters for the measurement of consumption, showed that the latter was consuming 2¾ feet per hour and the former 7½ feet per hour.

The light produced either with fuel or ordinary illuminating gas burning upon the incandescent cone was beautifully clear and white. Upon a table a dozen or more different delicate shades of silks were shown under the illumination of a jet of ordinary illuminating gas and a jet of fuel gas with the incandescent burner. Under the latter the shades appeared as they would in clear daylight; under the former the shades were dull, and, in a number of instances, it was difficult to believe, without actual proof, that certain shades in reality were the same as they appeared under the incandescent gas light.

A light of yellow tinge was also shown. It was designed for those who prefer that tinge to the white light.

The cones are guaranteed to burn a thousand hours. The cost of the cones could not be given.

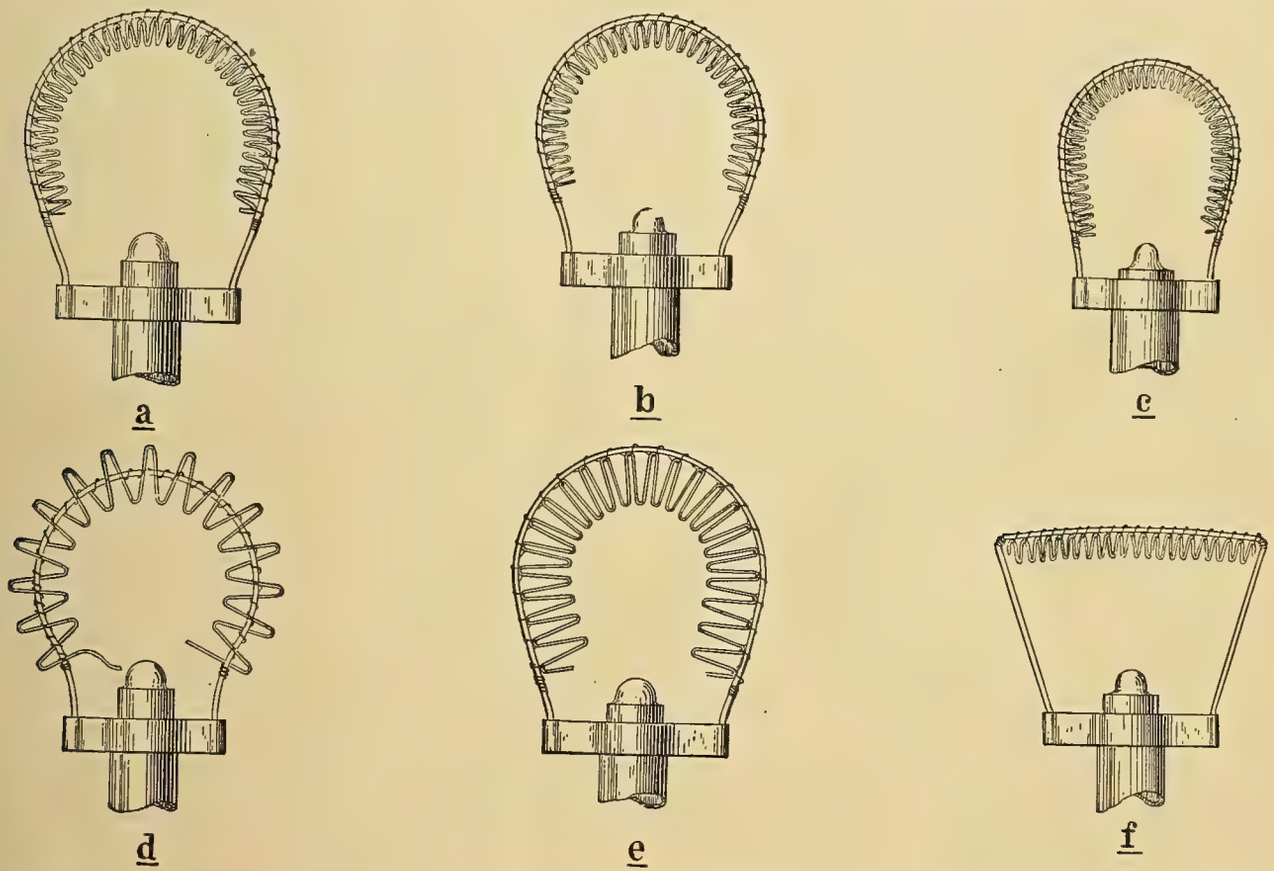
THE FAHNEHJELM INCANDESCENT GAS LIGHT.—The local company of this name occupies handsome quarters at 704 Royal Insurance building. The burner reminds one of the old fashioned tortoise-shell comb so dear to the hearts of the grandmothers of the present generation, with the exception that it is flat and the two outer teeth are formed of wires longer than the other teeth, which set into sockets provided for them in the fixture. The inner teeth form the incandescing portion of the burner. When the burner is in proper position the flame first strikes the lower part of the teeth of the comb.

The composition of the burner is Greek magnesite which is subsequently calcined. The burner can not be used in conjunction with ordinary illuminating gas but is confined to use with fuel gas.

The light is clear, beautiful, white and steady, and tests with delicate shades of silk proved very satisfactory,so much so that the statement of W. D. Eaton, who was in charge, that an analysis of the light furnished by this burner showed it to be the same as that furnished by Old Sol himself could be readily believed.

The combs are guaranteed for 100 hours; some were seen that have been burning for 500 hours and an attempt is being made to increase the life to 1,000 hours. The combs are sold at the nominal price of three dollars per hundred or three cents each.

THE LUNGREN BURNER.—This burner is the invention of Charles M. Lungren of New York, who has reached the same perfection of steadiness, clearness and whiteness secured by other inventors. As shown in the cut, the burner consists of a tubular chamber *1* mounted upon the pillar *B*, and provided with a row of perforations on its upper side. The incandescing material *C* consists of a flattened coil suspended upon the platinum wire *P*, which is carried by the spring arms *S*. To prevent the coil swaying to and fro under the impact of the issuing gas or from vibration, it is cemented to the platinum wire, so that the wire and coil form one piece, which can be readily handled, when it is being put in position on the burner. The coil is composed mainly of magnesia to which certain other ingredients have been added for the purpose of improving the quality of the light. Magnesia, as indeed almost all the metallic oxides, yields when incandescent a bluish white light, which gives to all objects a ghastly appearance. It has been found that by adding to the magnesia certain materials, this bluish cast can be avoided and the color made anything desired, from a reddish yellow to a clear white with a slightly yellowish tinge. When the gas is lighted, the spiral becomes brightly incandescent, the incandescence extending very evenly over the whole surface.



FORMS OF LOWE BURNERS.

THE LOWE INCANDESCENT BURNER.[1]—Our readers will doubtless remember that we published a report some two years ago from Drs. Wahl and Ward, of the Franklin Institute, on one of Professor Lowe's new incandescent burners, made of a composition in which magnesium predominates. This burner is in the form of a cylinder, and gave a light of 210 candle power with a consumption of three and one-half cubic feet of gas per hour. Up to this time no other gas light, incandescent or otherwise, had been produced which consumed less than ten times as much gas as this one. The accompanying cut, Fig. 1, represents the burner about as it will appear in general use.

It will be noticed that the cylinder to be heated to incandescence is firmly held in place on a metal spindle, which is slowly revolved by means of an ingenious clock-work in the base of the fixture. The arrangement is such that by the turning off of the gas the clock-work is stopped, and by the turning on of the gas it is again set in motion. The movement of the spindle is so slow that a casual observer would not notice it, there being only one revolution made in twenty-four hours. The object of this movement is to continually present new surface to be heated, as that which is exposed to the high temperature wears away, similarly to the carbons used in electric lighting, though much more slowly.

These burners can be made of 2,000 candle power, down to fifty candle power, and consume no more gas in proportion to candle power obtained than the burners tested by Drs. Wahl and Ward. Following is the report referred to:

THE FRANKLIN INSTITUTE, SECRETARY'S OFFICE, PHILADELPHIA, November 12, 1885.—*My Dear Prof. Lowe:* Dr. Ward and myself this a. m. worked out the results of our observations on the sun burners measured on Wednesday. They work out as follows:

Lime cylinder	121.72 candle
Magnesia	210.63 "

Difference in favor of magnesia, 86.3 per cent.

CONSUMPTION.

Water gas	2.52 feet per hour.
Oxygen	.9 " " "

Yours, etc., WM. H. WAHL.

Pure oxygen can now be obtained from the atmosphere at a cost of about twenty-five cents per 1,000 cubic feet, and the small amount required to supplement the fuel water gas in producing light can be supplied under proper pressure from a very small pipe, which can be laid in the same trench with the fuel gas pipe, at much less cost than is required to carry an electric wire to produce an equal amount of light.

The oxygen pipe necessary to carry the gas under pressure, need not exceed an inch and a half in diameter, to supply 5,000 lamps of 2,000 candle-power each. The only reason why this burner has not been further perfected and placed upon the market, is because of the continual preoccupation of Professor Lowe in other lines of invention, and the amount of attention required by his large business interests. Besides, the field for its usefulness has been limited, as cheap fuel gas has only just begun to be generally introduced. Now, however, that extensive preparations are being made for the rapid introduction of the Lowe fuel gas systems into various cities, this burner will receive sufficent attention to shortly complete it for general use in large quantities. The light is more powerful and at the same time softer than the electric incandescent or the arc light.

The light-giving property of a burner of 1,000 candle power would not cost more than one cent for ten hours' lighting, and the cylinder

1 *Progressive Age and Water Gas Journal*, January, 1888.

would only require to be changed once a week; whereas, the carbons of arc lights are changed daily. The cost of the gas required to maintain such a lamp for ten hours would be six cents, allowing the same profit on the gas as when it is sold for other heating purposes. The lamps complete will cost much less than the present electric lamps, and after allowing a large profit to companies supplying them, will not cost consumers more than one-fourth as much as arc lamps, and will give a much clearer and steadier light.

Since Professor Lowe perfected his first incandescent burner great progress has been made in this line of invention, and it is no wonder that the attention of the whole gas fraternity of the country has been drawn to the subject of cheap fuel water gas, which is so admirably adapted to all purposes of heat, light and power.

While there is no doubt that light can be more cheaply produced by incandescence obtained by the use of fuel water gas than by any other means, still a large amount of electric lighting will continue to hold its position, and the electric system will gain ground for many uses. But the electric light also can be more economically produced when fuel water gas is used as power to operate the dynamos. Therefore, we believe it to be for the best interests of every gas company that would move in the line of progress to commence without delay to make preparations for the introduction of fuel water gas, if, at first, only as supplementary to their present illuminating gas business.

In this connection several full sized forms of Professor Lowe's incandescent gas burners are reproduced, Fig. a showing a three-foot helical burner; b, two-foot helical burner; c, one-foot helical burner; d, "star" burner; e, flat flame burner; f, one-foot straight helix burner. The smallest size gives a ten-candle light, while the largest size, will give twenty-candle light by the use of fuel water gas. The burners are composed of four or five of the rare indestructible metals. Two years practice has shown that there is no deterioration in the metal itself, and if by chance, as sometimes occurs, these burners get knocked or twisted out of shape, so that the light given by them would be unsatisfactory, they can be exchanged at the cost of five cents for a new filament.

Fuel gas and the evolution of the incandescent gas burner.—A New York correspondent furnishes the following interesting data: Fuel gas has been simmering for a long time. In 1880 and 1881 an attempt was made to manufacture a fuel gas under the Strong patents, but the time was not yet ripe for the project and the scheme failed through the quarrels of the parties interested. While the question of fuel gas continued to occupy the attention of engineers and others interested in it on its scientific side, nothing until quite recently has been attempted in a commercial way. The advent of natural gas has, however, brought the question again to the front, and it is receiving serious attention in the gas world. The bar to serious attempts at the introduction of fuel gas has heretofore been the lack of any means of obtaining light with such a gas. It involved the use of two sets of mains to furnish both light and fuel. Westinghouse has indeed proposed to solve the problem by distributing gas for fuel, and electricity for light, but naturally his scheme would not command the enthusiasm of gas men.

Efforts to make an incandescent gas light date back a long time. About 1845 such a burner was tried on hydrogen gas in Paris. The burner consisted of a cage of platinum wire brought to vivid incandescence by the burning gas, but nothing ever came of the project, as there was then no economical means of producing such a gas. Numerous experiments were carried on, both in this country and abroad, by Tessie Du Motay in the years from 1869 to 1871 with the object of obtaining a gas incandescent, but his work was wholly with pencils of the refractory earths and the blow-pipe flame fed with oxygen. He finally had resort to a carburetted water gas, supplied at first with oxygen, and later burned in the ordinary way. The Municipal Gas Light company of this city was founded to use his processes, and still makes water gas, it is believed by his method. Since 1880 a number of experimenters have been at work on the problem of an incandescent gas light, Clamond in Paris, Lungren in New York, Fahnehjelm in Sweden, Lewis in London, and more recently Aner Von Welsbach in Austria. All of them with the exception of Lewis have been working with the highly refractory metallic oxides, such as zirconia, lime, and magnesia. Lewis has been working in the direction of making the platinum metals subservient to the purposes of incandescence, and his, as well as the Clamond lamps, were exhibited in London in 1883. Both of these lamps are again being brought to notice in an improved form. The Fahnehjelm lamp was first brought to notice in 1884 and was brought to this country in 1885 by the late Geo. S. Dwight, who had given much time to the attempt to induce European gas engineers to make use of the Strong process of fuel gas. It is in use, your correspondent is informed, at Essen, Germany, and is represented as having proved practical. The Welsbach, the latest of the European lamps, has been heralded with much parade, and great claims are made for it. It has been brought to this country and is now on exhibition. Something like thirty millions of capital stock have already been based upon it and it is intimated that the parent and local companies will shortly begin business on a great scale. The last to make its appearance in the commercial field, but the earliest in its inception, is the Lungren. While Mr. Lungren obtained very promising results as far back as 1880 and 1881, it is only within a short time that he has been able to get his burner into a shape that would warrant its commercial introduction. In the patent office he has successfully established his priority and in consequence two broad patents were issued to him last summer.

CORRESPONDENCE.

New York Notes.

New York, Jan. 14.—To a stranger in the city, or to a resident travelling in some part of the city with which he is not familiar, it is most provoking to find the names of the streets not indicated at each crossing. The system of putting the street names on gas lamps has been very satisfactory, but since the gas lamps on the principal streets have been replaced by electric lights, complaints have constantly been made that at night it is a difficult matter to find the street of which one is in search. In daytime the tin signs on the lamp posts can be easily read, but at night they are perfectly indistinguishable. Many suggestions have been made as to the best way of overcoming this difficulty. One plan proposed is to put the street name upon the glass globe of an arc lamp so that the shadow would be thrown upon the sidewalk and appear there in letters two or three feet in height. The question is a difficult one to settle satisfactorily. Here in New York the department of public works is putting signs, composed of white letters upon a blue background, on the corners of all buildings where permission can be obtained from the owners.

The Consolidated Electric Light company will soon move their general offices from the Mutual Life Insurance building on Nassau street to their own building on Twenty-Third street, numbers 510–534. Here they will have by far the largest factory in the world devoted to the manufacture of incandescent lamps, the capacity being 10,000 lamps per day. The building, which the consolidated company recently purchased, has a frontage of 325 feet on Twenty-Third street, is six stories in height, and has a floor space of about 200,000 feet.

A Fourth avenue car, operated by Julien storage batteries, made its 120th trip yesterday, and it has never broken down or failed. Ten more cars now building will be ready about the first of April, when they will be put on regular work in place of ten of the horse cars which the Fourth avenue company now run between the Grand Central depot and the post office. These will be entirely new cars, but the ten horse cars which will displace will then be fitted with batteries and put to work in place of ten other cars, and in this way the whole rolling stock of the line will gradually be changed. The Julien company claim that with ten cars the operating expenses will be about fifty per cent less than if horses were used.

A dispatch from Easton, Pa., states that the test of a new electric road there day before yesterday proved entirely satisfactory. The road was built by the Electric Safety company of New York, using the Daft system, and the experiment was of special interest on account of the steep grade, the rise for a distance of 1,200 feet being about nine feet in every 100.

The Geneva Non-Magnetic Watch company have an attractive exhibit in Benedict's show window at Broadway and Cortlandt streets. A C. & C. motor is in operation, and several horse-shoe magnets are surrounded by non-magnetic watch movements. The watches are placed so as to get the full force of the magnetic influence, but apparently they are not at all affected.

New catalogues for 1888 are now having a wide circulation and are welcomed by the trade. Those published by Partrick & Carter, and Shaw & Geary, of Philadelphia, and the C. & C. Electric Motor company, of New York, are particularly attractive. A.

A Happy Dedication.

Fort Wayne, Ind., Jan. 14.—On the evening of January 5th, the employes of the Fort Wayne Jenney Electric Light company dedicated their newest building with a dance. The structure is a handsome one, built close to the Pittsburgh, Fort Wayne & Chicago railway. It is three stories in height and measures 112x41 feet. The entire second floor was converted into a ball room, which was brilliantly illuminated by arc lamps. The programme was ingeniously and happily constructed and is presented in full:

1. Grand March
   Complete Circuit.
2. Quadrille
   Eight in Each Group.
3. Waltz
   Rock 'er
4. Quadrille
   Electric Shock.
5. Schottische
   Magnetic.
6. Quadrille
   Leap Year, Jenney's Choice.
7. Varsouvienne
   Mica Insulation.
8. Quadrille
   Arc, Direct and Alternating.
9. Waltz
   Reversed.
10. Quadrille
    Wild Irishman—"Isolated."
    Circuit Grounded.
    Supper. Cut-Out.
    Malleable Iron Couplings, with Double-Pointed Tacks.
11. Polka
    Magneto Bells.
12. Cecilian Circle
    Alternating, 1,000 Voltz.
13. Schottische
    Met'er.
14. Quadrille
    "Balance (all) Three Wire System."
15. Waltz
    "Current Upside Down."
16. Virginia Reel
    Double Wound.
17. Quadrille
    Watt? Switch out the Lights.
    Conductor 'Ohm.

Among the guests were H. G. Olds, president of the Jenney company, and Mrs. Olds, P. A. Randall, the company's vice president, and Mrs. Randall, Chas. B. Fitch and Mrs. Fitch.

At the conclusion of the dance the employes, some 250 in number, handed to the officers of the company and the superintendents of the arc and incandescent departments, a card of thanks for their kind interest in promoting the success of the affair. They express a hope that the Jenney company may find it necessary to add, each year, a new building to the large works, and that they may be present to assist at the dedications. Inasmuch as the erection of another large building is in immediate prospect, the hopes of the employes seem nearer realization than they knew. C.

From St. Louis, Mo.

St. Louis, Jan. 14.—Your correspondent inadvertently committed an error in the letter published in the January 7th issue, in regard to the Pond Engineering company of this city, in this statement: "The Pond Engineering company, which makes a specialty of installing complete electric lighting plants, has a number of heavy

contracts on hand. The concern is noted for the general excellence of its work." The company make a specialty of installing complete steam plants in connection with electric lighting, ending their work at the belt from the engine to the dynamo; with the electrical part of the plant they have nothing to do. By rigidly adhering to this policy the company have been able to work up a large business and to secure the contracts referred to in the quotation.

The *Globe-Democrat* of this city pays the Shultz Belting company a handsome and well-merited compliment: "The enterprise of the Shultz Belting company, a prominent local industry, was most excellently displayed a few days ago and in a way that could not be surpassed by any similar institution in the country. It seldom occurs that such a concern is offered an opportunity to show what can be done on short notice, but the test came Saturday afternoon at 3 o'clock, when the Brush Electric-light plant was burned out, completely destroying all the belting of that extensive establishment. The consequence was that darkness hung over the stores of the company's patrons, and they began calling for electricity. There was no way of producing a current without belting, and as the sizes wanted were of such unusual dimensions none could be found in stock. Therefore the Shultz Belting company began that afternoon to manufacture belting from the leather which they had on hand. By working their forces night and day they succeeded in having the Brush plant in full operation again at 3 o'clock Monday afternoon. In the meantime, five double 12-inch one double 20-inch, one double 24-inch, 210 feet of 12 inch, 72 feet of 20 inch and 72 feet of 24-inch leather belting was cut, made and fitted accurately to the electric pulleys. This is the quickest job ever accomplished in this line of manufacture, and is fully in keeping with the enterprise of the firm, which is second to none in the country. Its trade is represented by agents in all the principal cities of the United States, and the factories' products are shipped to France, Holland, Mexico and even to Cairo, Egypt."

THE ELECTRIC LIGHT.

Hagerstown, Md., invites proposals for erecting an electric light plant.

An electric light plant will be erected at Cleveland, Tenn.

Elberfeld, Germany, has the Edison three-wire system electric light plant.

Plymouth, Ind., has granted its electric light franchise to the Jenney Electric Light company.

The Brush Electric Light company is erecting a plant at Carlinville, Ill.

Great Barrington, Mass., will install an Edison electric light plant.

Newton, Kan., has just added two Thomson-Houston 25 arc light dynamos to its present good size plant of that system.

The El Dorado, Kan., Gas company started a 35 arc light plant of the Thomson-Houston system on the 1st of January.

The Arkansas City, Kan., Gas Light company, began the new year by installing an arc plant of 70 lights of the Thomson-Houston system.

The Oakland, Cal., Gas company recently increased its Thomson-Houston plant by adding two 35 lighters.

A new use has been discovered for the electric light. The body of a boy drowned at Winchendon, Mass., was found through the use of the electric light, a bulb being fastened to a pole and submerged, illuminating the water for a considerable distance in the neighborhood.

John Berry, employed by the Schuyler Electric Light company in Wichita, Kan., received a very severe shock some time ago. He was unconscious for several days but finally recovered. A few days ago it is reported he became violently insane.

The corner stone of the magnificent ice palace at St. Paul, Minn., was laid on the 14th inst. The electric lights were turned on inside the palace walls, and shining through the blood-red globes, turned bastion, battlement and turret into pillars of fire, giving all the fascinating effects of a Walpurgis night.

At Lowell, Mass., January 12th, two large four-story brick houses, owned by the city and occupied by the fire department and by companies C and G, sixth regiment, as an armory, were destroyed by fire. In one building were 20,000 rounds of cartridges, which kept up a constant fusilade, and several kegs of gunpowder, which exploded with such force as to be heard all over the city. The fire alarm telegraph system was rendered useless and every electric light in the city was extinguished. The electric light station was in close proximity to the fire and the wires were destroyed. The buildings owned by the city were valued at $35,000.

The electric light plant in McPherson, Kan., is running 44 arc lights, and 325 incandescent lamps. The price is $10 per month for arc and 65 cents for incandescent without any extra charge for putting in lamps. At Marion the charge is $12 per month for arc with cost for putting in; 75 cents for incandescent and $2.40 for putting in lamps.

The McPherson, Kan., electric light company are making arrangements to put in a new boiler.

The Macon, Mo., Gas and Electric Light company has filed articles of incorporation. The capital stock is $24,000, one-half paid in.

J. A. Jones has been granted the right to erect the electric light plant in Oswego, Kan.

The Marion, Kan., Water & Electric Light company has just started a plant of 400 lights of the Thomson-Houston alternating system and a plant of 50 arc lights.

Says a Parsons, Kan., paper, of recent date: The electric light company have been endeavoring for some time to adjust their machinery so that the lights would not flicker, but without success until Thursday, when they found that the trouble was caused by the belt slipping on the steel pulley on the dynamo. The wheel was removed and a wooden one substituted, which effectually remedied the difficulty and the lights now burn with great steadiness and brilliancy.

THE ELECTRIC MOTOR.

Arrangements are nearly completed for the organization of a company and the construction and operation of an electric road between Detroit and Mount Clemens, a distance of twenty-two miles. It will be the longest electric road, it is said, in the country. It is proposed to locate a central station about midway between the two terminal points, where the motive power for the entiresystem will be generated. There will be three electric motors of 50 horse power each, a 200 horse power generator, with boiler and engines commensurate, and $20,000 worth of half-inch copper wire conductors.

Electricity is to be utilized at the Paradise Valley mine, Winnemucca, Nev., for lighting the workings and pumping water. The dynamo will be run by water power six and one-half miles distant, and the current will be conveyed through wires placed on the existing telegraph poles. A motor to raise water 420 feet will be placed in the workings.

President J. H. Lightner, of the Lindell — Washington avenue — street railway, said to a St. Louis *Globe Democrat* reporter January 14th that, after having expended nearly $10,000 in experiments with electric motors, the company had finally decided that the electric storage battery system was the best in use. Its principle is that of the Julien battery, which has been in operation on street railways of Brussels, Berlin and Antwerp for two years. The batteries are charged at a power house and are placed under the seats of the car, being set in position through a door in the side of the car. When set up there they are ready for use. One plan is to have the machinery worked by an endless chain, or ropes, and another is to have it operated by cogs attached to an axle. "We have tried this motor over the road a number of times," said Mr. Lightner. "In our last experiment we had power to spare, not using all we had. The difficulty attending the experiment was that the large and small wheels we used created so many revolutions that there was a disposition of the wheels to slip and make hot boxes. In our next experiment we will use wheels nearly of equal size, and yet we expect to get power sufficient to run the car. Again, our cars can be lighted instantly with a brilliant electric light from the same batteries that propel the car, so that passengers will have the advantage of reading on the cars if they want to. We are looking daily for the arrival of some of these machines to experiment further with."

THE TELEPHONE.

At Elkhart, Ind., on the 11th the Bell Telephone company franchise was given to the Cushman company, of Chicago.

The suit brought by the Chicago Telephone company against the Commercial Quotation company, and tried before Justice Going, was decided by him in favor of the former, awarding them their claim of $15.62 for one-half of the unexpired quarter for which the Quotation company had contracted. The main fight was made by the defendant upon the grounds that plaintiff did not bring forward the necessary documents to prove they were an incorporated company, and citing a number of authorities to prove their obligation to do so. The counsel for plaintiff claimed the defendant had no right to enter such a plea, not having intimated such intention previously, thereby giving plaintiff no opportunity to provide an answer. Both sides rehearsed somewhat briefly the testimony brought out at the trial. The defendant claimed that the contract was signed because it was the only way of securing a telephone, the company having a monopoly: that the service was such as to cause the defendant to deem it "a nuisance." Witnesses for the defense all swore to this, and it was fruther shown that insufficient help was the reason for the trouble. Defendants claimed that they needed a telephone, and only ordered theirs out when it was found to be useless. The plaintiff's counsel said the Quotation company did not deny the telephone company was an incorporated body, but they would not admit that they were. Had it been surmised such a matter would be in dispute they could easily have provided themselves with evidence to prove their incorporation. In regard to service they showed defendant's office was called up about seven times a day and that in general they did not answer, giving the impression that no one was there, and further the counsel for the plaintiff pointed to the clause in italics in the contract saying "the lessor does not guarantee the uninterrupted working of the line or instruments." It was no defense, he claimed, that the defendant did not read his contract. Judge Going, in giving his decision, went over the whole ground. He sustained the plaintiff in his argument that in this case there was no necessity of proving the act of incorporation, and for the rest it was a plain case. A man of intelligence had signed a contract and refused to fulfill its conditions. The law demanded he should do so, and so he adjudged.

It is said that City treasurer Plautz, County treasurer Davis and Assistant city attorney Knight are interested in the Chicago company that has applied for a franchise to operate an American Cushman telephone exchange in this city. Mr. Knight says in an interview "It is true, that the persons named are interested in it. The company was formed before the telephone question was agitated, and has been doing business at several points in Indiana for months. The company in that state is known as the American-Cushman, and we have simply bought instruments from it, acquired territory deserted by the Bell company, strung wires, and are doing business. Our proposition is to lay underground wires between Chicago avenue and Twelfth street, and for the first year give service at $80, and the second year for $70. Outside of the district named we want to put up aerial wires, and be treated the same as the other company. The price in Indiana is $3 a month, or $36 a year. We can not make the same figure here because the expense of underground wires would not admit of it. We use the same instrument as the Bell company, except it is made by the American-Cushman company. A suit is pending to test the question of infringement, but we have never been enjoined and we are going right along. The case will come before the United States court here in about a month, and if decided in our favor we will proceed to push our ordinance."

The growth of the telephone system in Europe, says the London *Electrical Review*, shows great variation in the several countries during the three years from the end of 1883 to the close of 1886. The increase in the number of telephone wires was greatest in Switzerland, where it was 1,700 per cent—from 2 in 1883 to 36 in 1886; Germany, 333 per cent—from 21 to 91; Austria, 267 per cent—from 3 to 11; Russia, 233 per cent—from 6 to 20; and Sweden, 200 per cent—from 5 to 15. Belgium and Holland follow a long way behind, with an increase of only 50 per cent—from 10 to 15. In Italy the number of telephone lines increased but 23 per cent—from 13 to 16; in Great Britain 19 per cent—from 75 to 89; and in France 11 per cent—from 18 to 20. Germany had at the close of 1886 the largest number of telephone lines, 91; and Austria the smallest, 11. The increase in subscribers has been in proportion to the growth in the number of lines. Switzerland here also heads the list, subscribers having increased by 486 per cent—from 835 in 1883 to 4,900 in 1886. In Germany the increase was 308 per cent—from 3,613 to 14,733; Russia, 291 per cent—from 1,451 to 5,280; Sweden, 267 per cent—from 1,553 to 5,705; Austria, 248 per cent—from 870 to 3,032; Belgium and Holland, 151 per cent—from 2,331 to 5,858; and Great Britain 107 per cent—from 7,287 to 15,114. France and Italy are at the bottom of the list, the increase in the number of subscribers in the former country having been only 62 per cent—from 4,437 to 7,175, and in the latter 52 per cent—from 5,507 to 8,346. Great Britain still had the largest number of telephone users, 15,114; Austria the smallest, 3,032.

The Chinese officials are so highly pleased with the Van Rysselberghe system of simultaneous telephony and telegraphy that they have decided to have it put in operation on the line between Shanghai and Tien-Tsen.

Walker's portable miner's electric lamp, of English invention, consists of a bichromate carbon-zinc battery, which supplies the current, and an incandescent lamp. There are two sizes, one round containing two cells, the other oval containing three cells, the carbon itself being the containing vessel, and the cells being constructed with the usual porous cups and zincs, and closed with two india-rubber pads, the outer one being attached to the cover. Above the cells is the lamp placed between a strong lens and a parabolic reflector, connected together by a brass frame. An outer case of brass incloses the whole apparatus, and is surmounted by a stout handle. The smaller lamp weighs five pounds, and gives sufficient light for reading ordinary print at a distance of six feet. It can be used for ten hours without renewal. The cost of renewing chemicals, keeping in repair and renewing incandescent lamp when necessary, is said not to exceed three-fourths of a penny a day for the small lamp, and one penny a day for the large one.

THE TELEGRAPH.

At the annual meeting of the stockholders of the Board of Trade Telegraph company, held in Chicago, the 9th inst., the following directors were elected: Edward S. Stokes, L. D. Parker, Dwight Townsend, H. A. Gardner, Frank Gilbert, C. W. Brega, James M. Ball. At a meeting of the directors Edward S. Stokes was re-elected president, Dwight Townsend secretary and treasurer, and L. D. Parker assistant secretary.

It has gotten to be a common thing for small sums of money to be transferred by cable between New York and London. A $20 order may be flashed under the Atlantic from New York in ample time to serve as a shopping fund in London the same afternoon. And the transfer is cheaper and easier now, not to say doubly more speedy, than it was a few years ago to send ten times the amount. Few people realize how closely the great cities of the world are connected by chained lightning and how cosmopolitan civilized humanity has become. The telegraph companies do this sort of banking business by wire every day between the cities of America. But it won't send $1 nor $1,000 at any price across the ocean. Banks will cable money in large amounts or for valued customers, but only at a cost prohibitive to moderate pocketbooks. The great banking houses will not transfer a smaller sum than £10, and then only at the rate of $5 per pound sterling, irrespective of current rates of exchange. After adding the cable tolls the operation becomes impracticable. But it remains a fact that much smaller sums are cabled across the pond daily and weekly and monthly without difficulty by people who know how to do it. English theatrical people playing arrangements in New York, or anywhere in the United States, constantly send a regular percentage of their salaries to friends or agents in the old country for domestic use or investment. Constantly on the go, and accustomed to the use of telegraphing for everyday purposes, the slow process of transmission by mail soon becomes irksome to them. They founded the system of cabling money to the other side, and it has already grown to most interesting proportions. They do it through their steamship agencies.

The Postal Telegraph company has leased the lines and property of the Connecticut Telegraph company, which adds to its facilities quite a number of additional towns and cities in Connecticut and Rhode Island, including Bridgeport and Ansonia, Conn., and Watch Hill and Narragansett Pier, R. I. The facilities consist of four wires from Bridgeport to Hartford, two Hartford to Deep River, one Deep River to Providence, two Providence to Watch Hill via Kingston and Narragansett Pier, one Hartford to New Boston, Mass., one Hartford to Stafford Springs and intermediate points.

The Commercial Union Telegraph company working in connection with the Postal in Vermont, Massachusetts and other New England States, and whose lines extend west as far as Albany, N. Y., have reached the city limits of New York, with their wires.

President John W. Mackay, throngh Vice-President Hector De Castro, informed all the employees of the Commercial Cable company in America and abroad that, as his Christmas gift, they were to receive an extra half month's salary. The gifts in the aggregate amounted to about $9,000. This is the third time that Mr Mackay has so rewarded the force.

The Chicago & Western Indiana railroad had a Patterson underground cable containing 20 wires between Sixteenth and Nineteenth streets, in Chicago. The Santa Fe road in making some improvements uncovered the cable and one night last week for the sake of the lead in the cable a thief cut out a section of about forty feet and made away with it. The cable was among the first made by the Western Electric company and had done excellent service.

Personal Paragraphs.

An Arkansas City paper says: Robert Gardiner manages the dynamo at the electric station on the Walnut. He almost inherits his knowledge of electricity. His father has charge of the fire alarm telegraph of New York city; his mother is in charge of the same in Detroit, and his uncle at Fort Worth, Texas. Although a young man he has had considerable experience in his profession.

Government inspector Frye who has under charge all electrical installations of the United States government has been in Chicago for a few days.

George H. Bliss has been elected secretary and general manager of the Sperry Electric Light company.

Miscellaneus Notes.

Orders have been sent to the various copper-producing mines of Arizona and New Mexico to resume work. This action is due to the abnormal rise in the value of the metal.

M. D. Babcock, inventor of the fire-extinguishing apparatus bearing his name, died at the almshouse in San Francisco, recently, aged 70 years; cause of death, softening of the brain. At one time he was in receipt of $10,000 a month for royalty on his machines, but after selling the patent rights the money was soon spent and for some years he wandered about the state in a destitute condition. About six years ago he was admitted to the almshouse, where he remained until his death.

A Findlay, O., press dispatch of the 14th says: The aluminum men who met here to-day to organize a trust to control the manufacture and sale of that metal throughout the United States, were in star-chamber session nearly all day and exceedingly chary about giving out any information regarding their proceedings, but it was learned that a "combine" was formed representing factories in Cincinnati, Louisville, East Saginaw, Chicago, Boston, New York, and Findlay, and that from this time on this metal will be furnished to those using it only on such terms and in such quantities as the trust may dictate.

Business Mention.

The Mansfield Electric company, of Boston, Mass., have removed to new quarters at 383 Federal street.

The C. & C. Electric Motor company of 88-92 South Fifth avenue, New York, issued on the 1st inst. a neat catalogue showing various styles of small motors, varying from ⅛ to ½ horse power, and applications to different purposes.

Johnson, Holland & Co. have recently moved from 227 LaSalle street, to handsome offices at 222, 223 and 225 Phenix building, Chicago.

The Electrical Supply company, 171 Randolph street, Chicago, have received several large orders for their new P. & B. weather proof line wire, and expect there will be a large demand for it in the near future.

The plant in Captain Anson's racquet court in Chicago is one of the Excelsior system, installed by F. W. Horne, western manager of the company. The longer the players use the light the better they like it.

Theo. P. Bailey, representing the Thomson-Houston company, recently took a contract for 1,500 incandescent lights of 16 candle power each for the Warder Grand opera house, Kansas City, Mo., and the plant has been installed.

At Minneapolis, Kan., the Thomson-Houston Electric company has just made a contract for 30 arc lights and 400 alternating. The same company has sold and is now constructing at Aurora, Ill., an alternating plant of 500 lights.

Electrical Patents.

Issued Jan. 10, 1888.

376,060. Telephonic Transmitter. Seth E. Beedy, Farmington, Me.

376,071. Electric Circuit Breaker. William R. Cole, Detroit, Mich.

376,072. Electrical Circuit Breaker. William R. Cole, Detroit, Mich.

376,116. Lighting Cars by Electricity. Arthur D. Stevens, Minneapolis, Minn.

376,120. Dynamo Electric Machine or Motor. Elihu Thomson, Lynn, Mass.

The capacity or efficiency of the machine is regulated or maintained by changes in the distributi n of the current in the field coils.

No regulator for adjusting the brushes is required. The invention is covered by twenty-three claims.

376,121. Electric Lock. Charles A. Tucker, Islip, N. Y.

376,133. Fire Alarm Circuit. John P. Barrett, Chicago, Illinois.

The invention is designed for use in engine houses, to prevent needlessly arousing the men at night.

376,149. Receiving Transmitter and Distributing Instrument for Electro-Magnetic Thermoscopes. Henry J. Haight, New York, N. Y.

376,171. Annunciator. Jacob P. Tirrell, Somerville, Mass.

376,228. Battery Zinc. John Beattie, jr., Fall River, Mass.

The zinc is of the crow-foot form. The invention consists in the post in combination with a supporting hook which may be bent to fit over the edge of the jar.

376,281. Pole Indicator for Electric Conductors. August Berghausen, Elberfeld, Germany.

A liquid such as glycerine and oil is contained in a transparent chamber. Platinum pins are placed in this liquid from opposite sides, and are connected with the conductor to be tested. The pin connected with the negative pole of the conductor becomes discolored.

376,307. Dynamo-Electric Machine. Francis Jehl, Paris, France.

The invention relates to machines used as generators or motors, of the class known as disk dynamos or flat ring dynamos. The armature is wound with flat over-lapping coils, the separate convolutions being arranged successively in advance of one another.

376,323. Electric Lamp. Luther H. Leber, York, Pa.

376,326. Armature for Dynamo Electric Machines. Hermann Lemp, Hartford, Conn.

The invention relates to the connections of the armature coils with the shaft wires leading to the commutator sections. The leading-in wires from the commutator sections pass through the hollow shaft which carries the armature and come out through holes near the armature coils.

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ESTABLISHED 1867.

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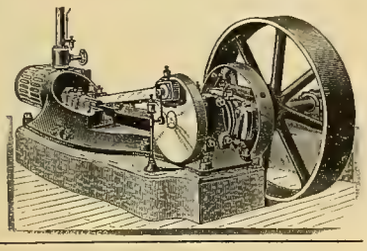

C. F. ANNETT, President. S. F. FENTON, Vice-Pres. and Treas. CHAS. S. SMITH, Secretary.

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Minnesota Branch, MINNEAPOLIS ELECTRIC CO., Minneapolis, Minn.
Nebraska Branch, MIDLAND ELECTRIC CO., Omaha, Neb.

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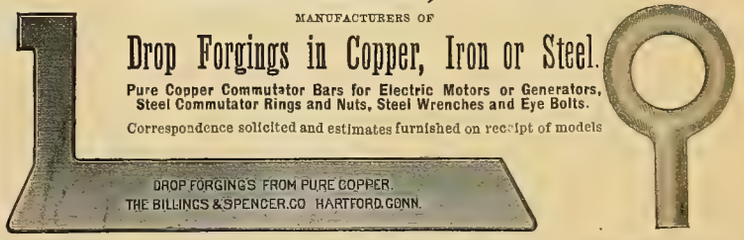

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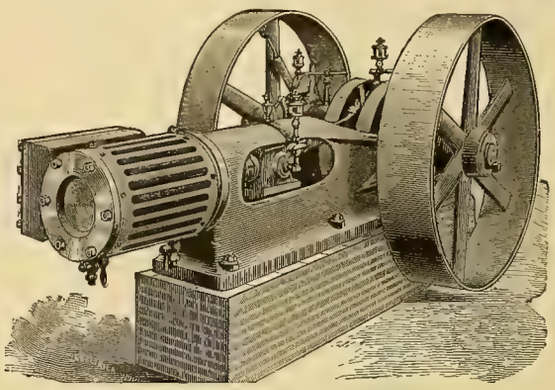

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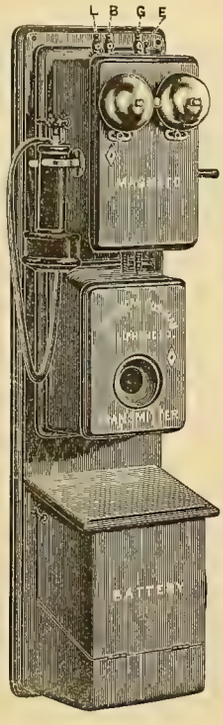

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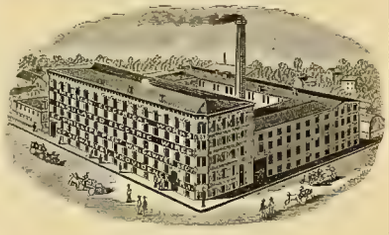

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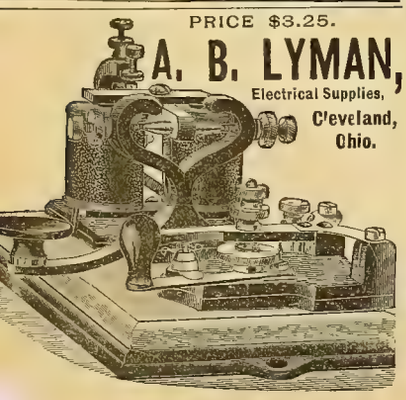

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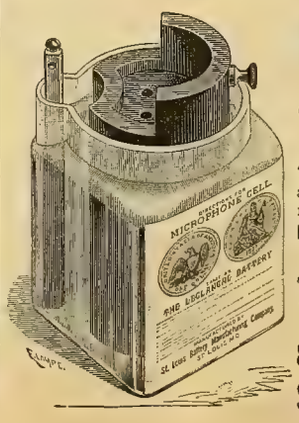

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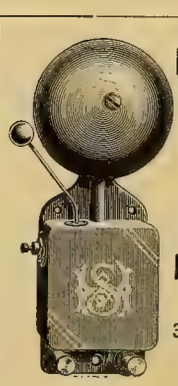

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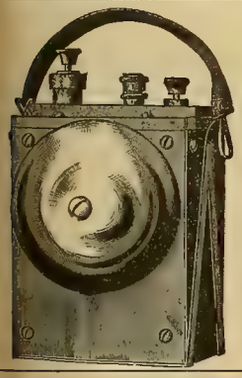

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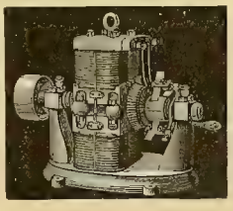

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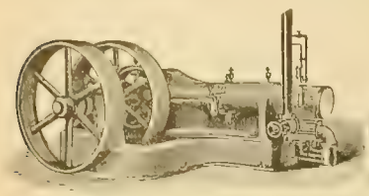

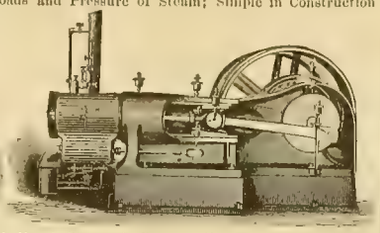

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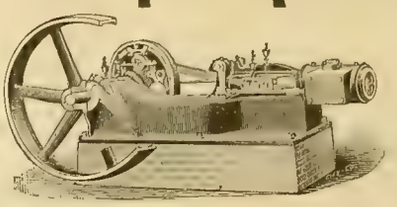

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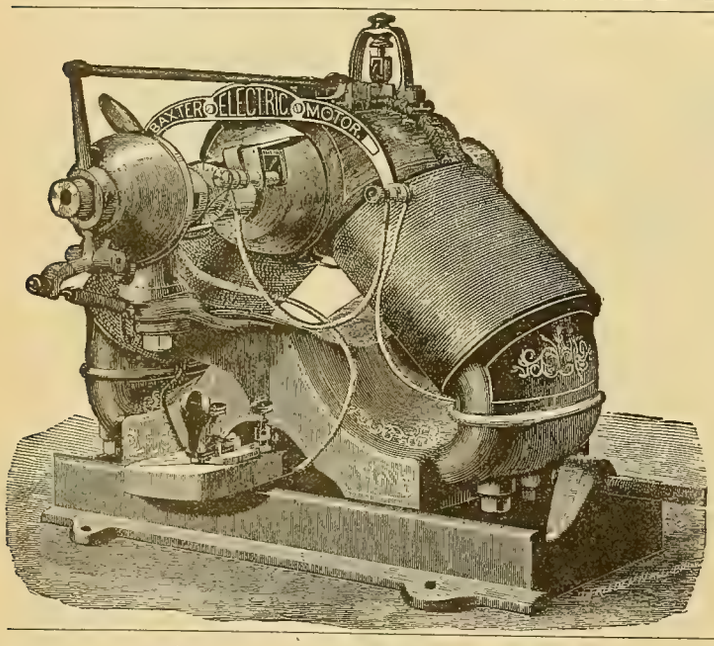

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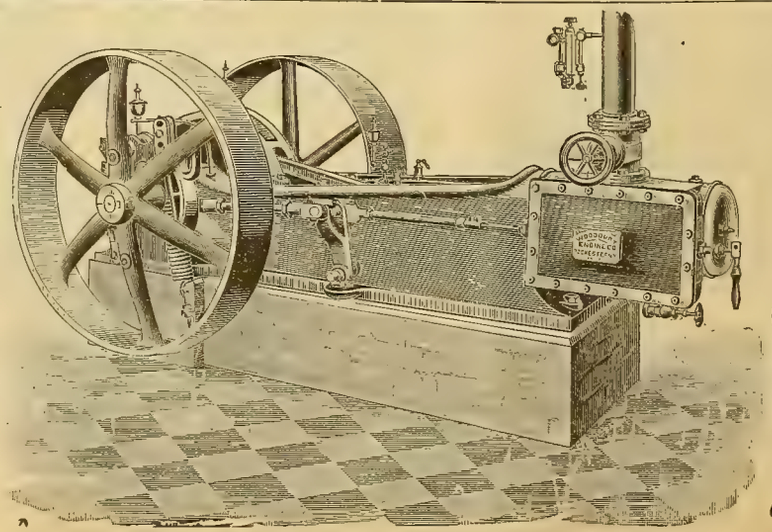

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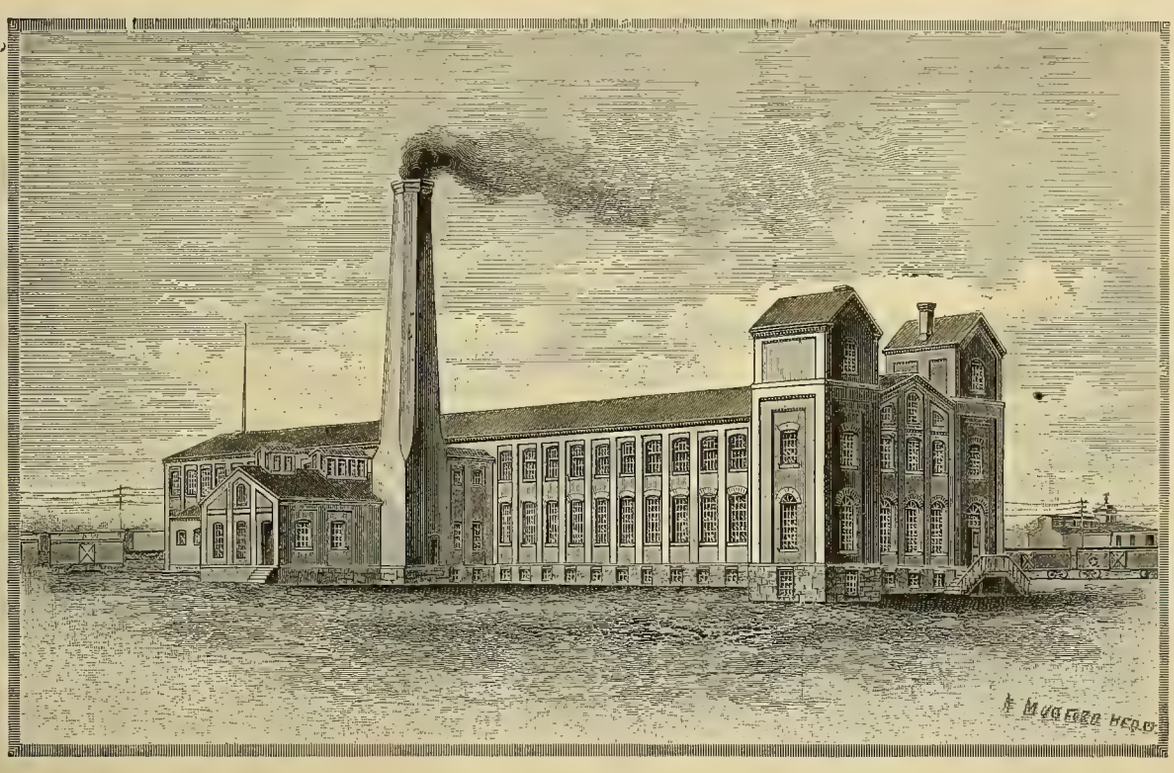

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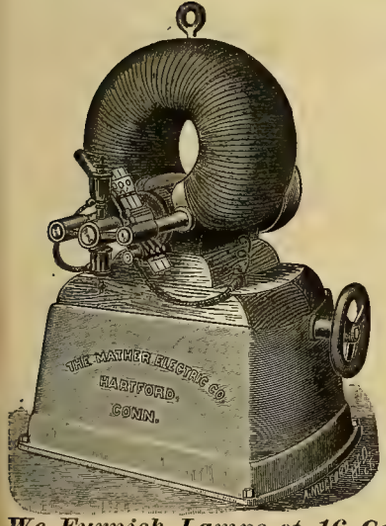

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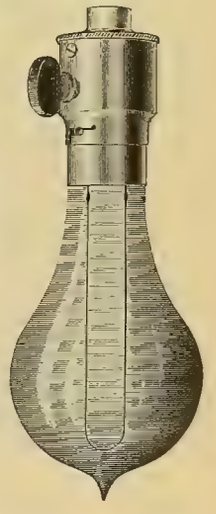

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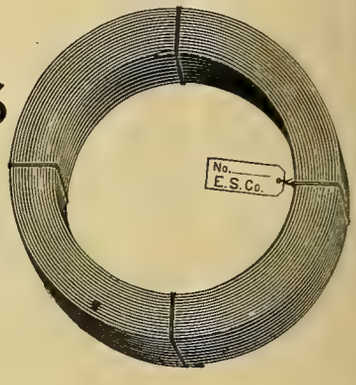

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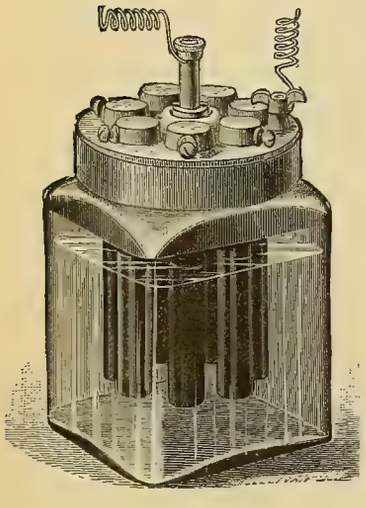

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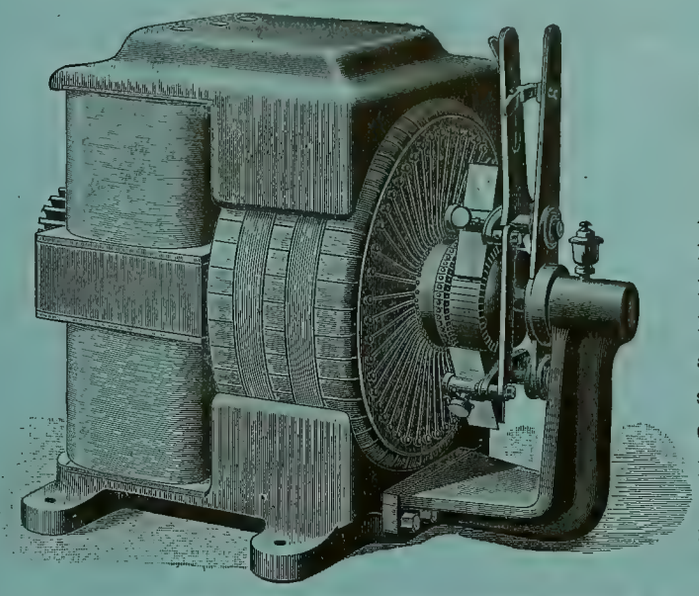

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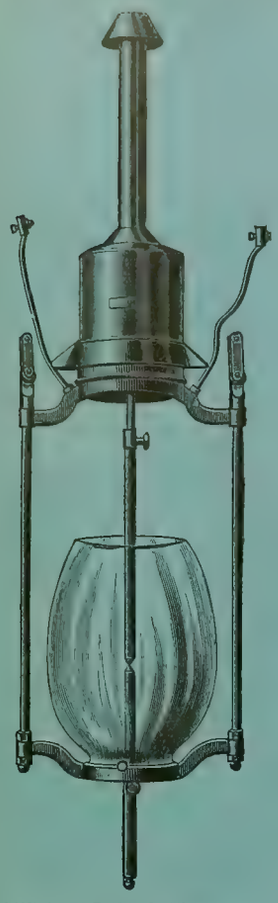

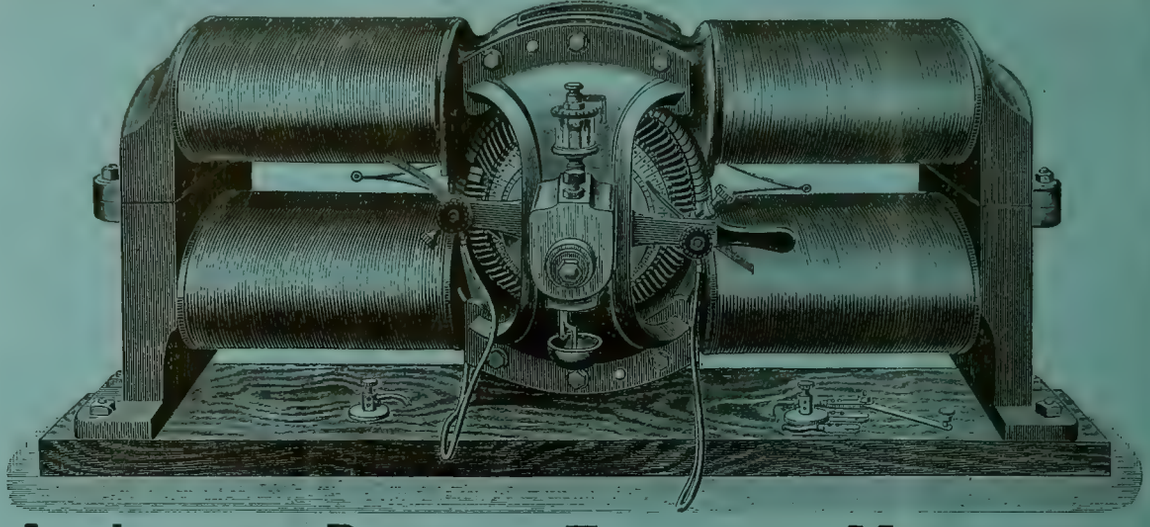

J. A. JENNEY DYNAMO-ELECTRIC MACHINES,

AND THE PERFECTLY AUTOMATIC AND SELF-REGULATING

JENNEY ARC LIGHT.

The JENNEY DYNAMO has no equal for SIMPLICITY, COMPACTNESS and DURABILITY. The same has been said and admitted to be true of the Jenney Lamp. Recommended for the award of the

ONLY GOLD MEDAL

At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

This system HAS NO EQUAL for SIMPLICITY, DURABILITY and STRENGTH OF LIGHT.

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. Full information furnished on application.

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MANUFACTURERS OF

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ELECTRIC

Lighting Apparatus.

Electric Motors!

CARBONS FOR ARC LAMPS. Etc., Etc.

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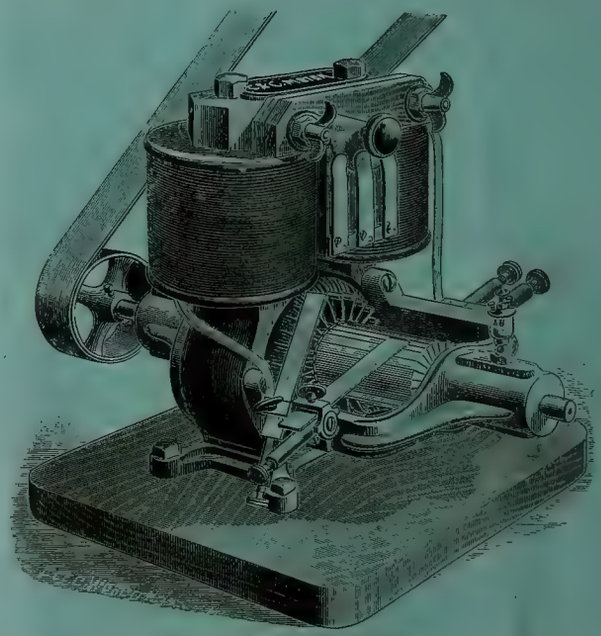
"C.&C." Electric Motor



1-2 H. P. Motor for Incandescent Circuit.

Efficient Electric Motors

WOUND FOR ANY CIRCUIT,

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Interchangeable Parts. Designed for Popular Commercial Use.

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Western Electrician.

EVERY SATURDAY.

Vol. II. CHICAGO, JANUARY 28, 1888. No. 4.

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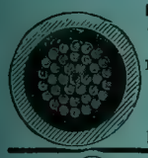

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LIGHT LEADED CABLES FOR HOUSE USE.

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Five Years of Uniform Success Enable us to Guarantee our Cables.

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TRINIDAD WIRES for Line Work in place of Underwriters.

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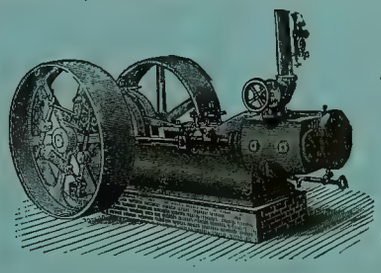

Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

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And other duty requiring close regulation of speed.

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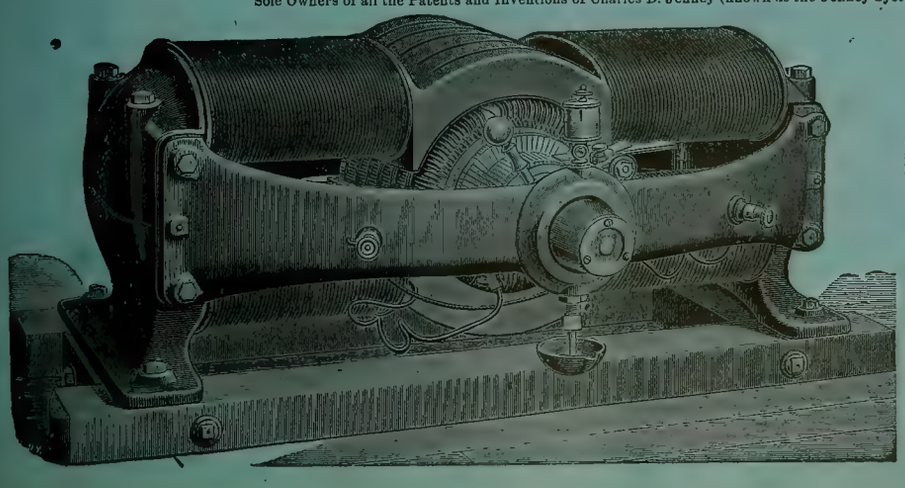
INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp & Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St.,

INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

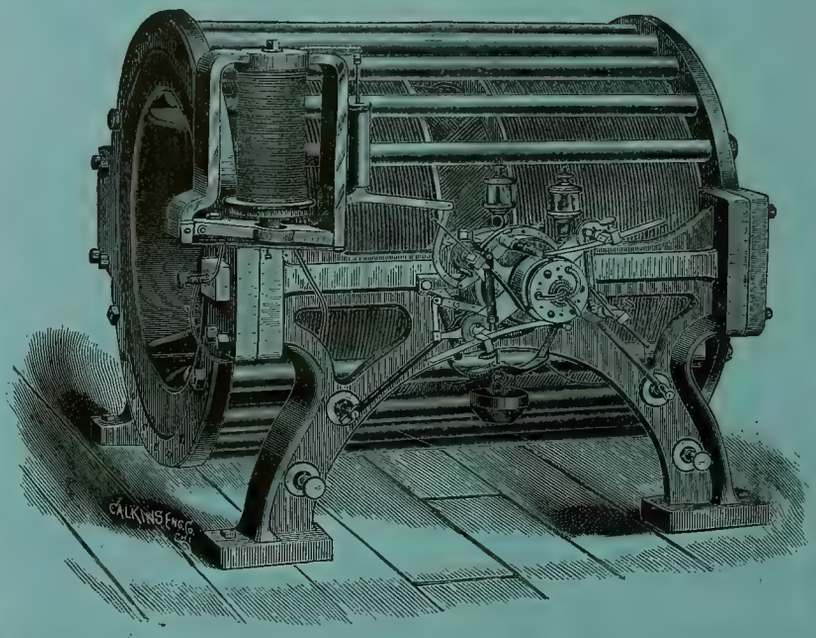
OF

Electric Arc-Lighting

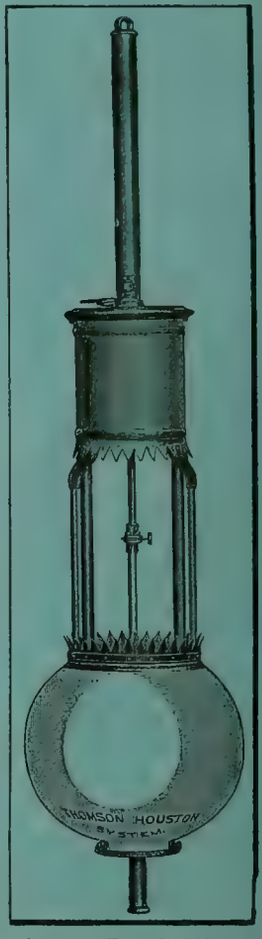
IN THE WORLD.

The Thomson-Houston Dynamos have no equal for simplicity, compactness and durability. The same has been said and admitted to be true of the Thomson-Houston Lamps. We were also awarded the FIRST MEDAL FOR THE BEST ARC LIGHT at the "Southern Exposition," at Louisville, Ky., in 1883. At the great Industrial Exposition at Cincinnati, the same year, received the FIRST PRIZE for the best system of Arc-Lighting. At the exhibition held at San Francisco in the summer of 1884, it received the FIRST GOLD MEDAL. At the most exhaustive competitive test of the various prominent systems ever made by a city, given at Quincy, Ill., was awarded the contract for lighting that city.

The Thomson-Houston System of Electric Lighting has been examined by the agents of insurance companies and pronounced perfectly satisfactory in fulfilling all the requirements laid down by them, and all lines and apparatus put up by the Thomson-Houston Electric Company conform to insurance rules.



The Thomson-Houston incandescent system of lighting possesses equally superior advantages. Its dynamo for direct low tension incandescent lighting possesses very superior features of simplicity and economy, and carries a greater number of lights in proportion to its weight than any other made.

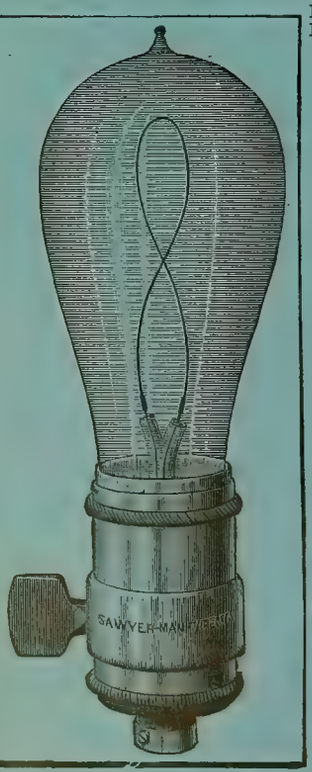


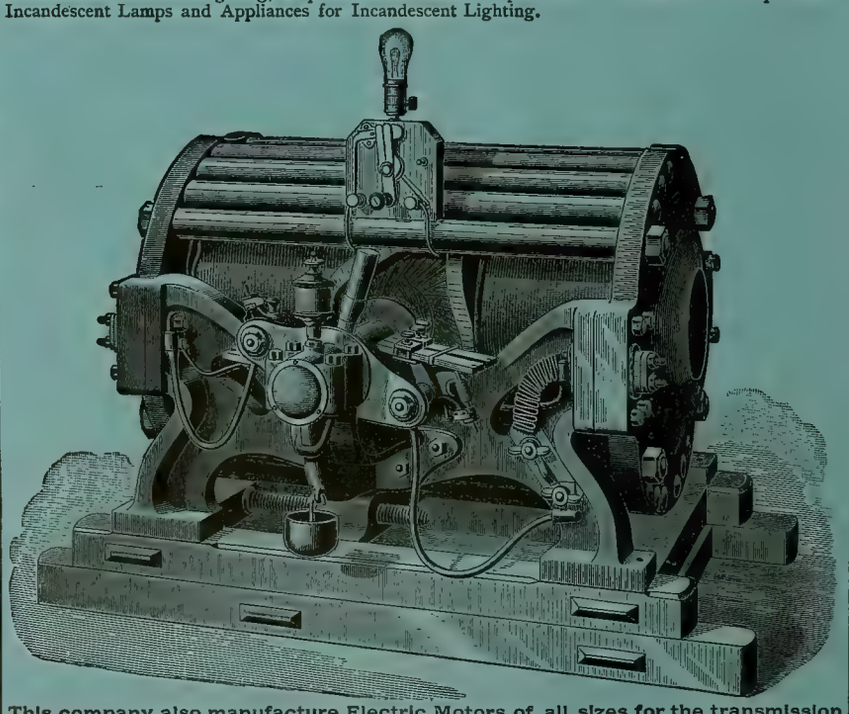
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform ight, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

MINNEAPOLIS, NOV. 17, 1887.

EDISON UNITED MANUFACTURING CO.,
65 Fifth Avenue, N. Y.

GENTLEMEN:

The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

U. S. OLD LAMP

IN GRAND OPERA HOUSE, MINNEAPOLIS.

WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful Indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of J. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=11$\frac{50}{100}$ per H. P.

EDISON 348 LAMPS REQUIRING 54 H. P.=6$\frac{44}{100}$ per H. P.

COMMENTS ARE UNNECESSARY.

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THE NATIONAL CARBON CO.

CLEVELAND, O.

MANUFACTURERS OF

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The Parker-Russell Mining and Mfg. Co.

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Adapted to all Systems.

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TRADE MARK COMPANY.

Electric Light, Telephone and Telegraph WIRES AND CABLES for Aerial, Submarine and Underground uses.

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ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

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BRANCH, 521 DELAWARE ST., KANSAS CITY.

Sawyer-Man Electric Co.

LICENSED BY AND SUCCEEDING TO THE COMMERCIAL BUSINESS OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

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Plans and Estimates Furnished for all kinds of Incandescent Lighting.

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

EDISON'S OPINION.

Geneva Non-Magnetic Watch Company:

Gentlemen:—During the past six months I have submitted the watches containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring to test in different fields of magnetism. I find them exempt from magnetic influence, however strong, and practically no retardation of the balance, nor change in rate occurs, even when in actual contact with Dynamos or powerful Electro-Magnets.

I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

For Full Information about the Watches referred to in the above Testimonial, address:

Geneva Non-Magnetic Watch Co.

(LIMITED.)

177 & 179 Broadway, New York.

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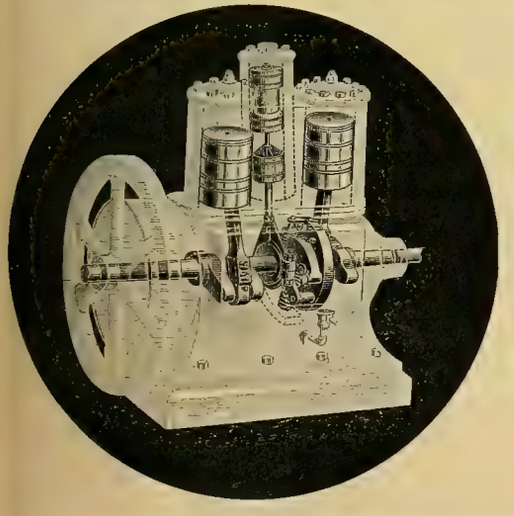
ALTERNATING SYSTEM,

MANUFACTURED AND CONTROLLED BY

The Westinghouse Electric Co.

PITTSBURGH, PA.

LOW COST. LONG DISTANCE. HIGH EFFICIENCY.



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SHAFTING { Costs to Purchase / Costs to Maintain / Costs to Lubricate / Costs to Drive } VERSUS THE **Westinghouse ENGINE.**

Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

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302 and 304 Washington Ave.....St. Louis.
1312 Union Avenue.....Kansas City.
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The D. A. Tompkins Co.
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FARADAY CARBON COMPANY

PITTSBURGH, PA.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. ANTWERP. LONDON.

MANUFACTURERS OF AND DEALERS IN

Electrical Apparatus and Supplies

INCLUDING

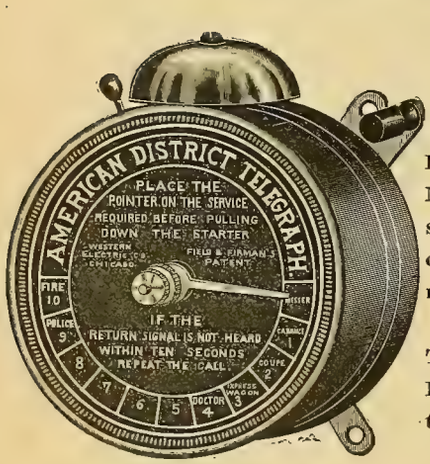
Patterson Cables, Insulated Wire and Cordage,

Electric Bells, Annunciators and Push Buttons, Electrical Testing Apparatus, Watchmen's Clocks, Mercurial Fire Alarm, Factory Telephone System, Hotel Return Call and Fire Alarm, Telephone Switch Boards and Edison Electric Pen, Electrical Books, Magneto Bells, Police and Fire Alarm Boxes, Registers, etc., Telegraph Instruments, Batteries, Linemen's and Inspectors' Tools.

Washburn & Moen Mfg. Co.'s Line Wires. Cross-arms, Pins, Brackets, Insulators, Carbons, Arc Light Globes, Etc., Etc.

Electric Lighting Apparatus

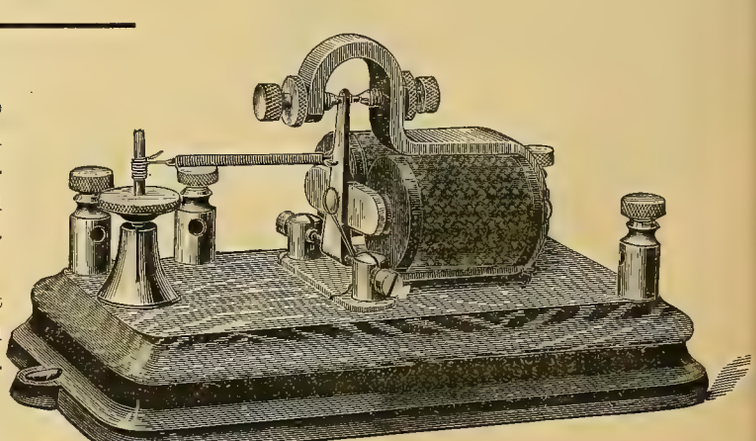
OUR SYSTEM OF ELECTRIC LIGHTING IS COMPLETE IN EVERY DETAIL, AND IS UNEXCELLED IN THE EFFICIENCY AND WORKMANSHIP OF THE APPARATUS, IN THE BRILLIANCY, STEADINESS AND COLOR OF THE LIGHT PRODUCED, AND IN AUTOMATIC REGULATION. WE FURNISH DYNAMOS TO GIVE ANY REQUIRED CURRENT. THE HIGH GRADE OF WORKMANSHIP AND THE EFFICIENCY OF OUR DYNAMOS RENDER THEM SPECIALLY ADVANTAGEOUS FOR CHARGING STORAGE BATTERIES, FURNISHING CURRENT FOR ELECTRIC MOTORS, ETC. WE FURNISH ARC LAMPS ADAPTED TO ANY ARC CURRENT. THE SUPERIOR CONSTRUCTION AND SIMPLICITY OF OUR LAMP RENDER ITS USE ADVANTAGEOUS WITH ANY SYSTEM.



Field and Firman Call Box with Answer Back Bell.

We are licensed under the Field and Firman patents on Multiple Call Boxes with Answer Back Attachment, and caution users against infringements of these patents.

We manufacture District Telegraph Bells, Relays and Registers of the best construction.



District Telegraph Relay.

WE HAVE STILL A LARGE QUANTITY OF

KERITE WIRE,

Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even **No. 16** gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes **Nos. 13, 14, 15 and 16.**

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, JANUARY 28, 1888. No. 4.

New Forms of Electric Light Fixtures.

We show in connection some new designs of fixtures for electric light plants made by the Electrical Supply company of Chicago. Fig. 1 illustrates a double strap switch and Fig. 2 a single strap switch for use on arc circuits. These instruments are strongly made and bear on their face evidence of their sound construction and durability. Figs. 4 and 5 on the following page also show switches made for incandescent circuits. Fig. 6 shows a circuit loop iron for cutting in a loop at any part of the circuit.

Fig. 3 illustrates a new style of pole top and reflector. This fixture is a neat, strong and convenient support for arc lamps of all the forms now in general use, and may be easily and quickly attached to any ordinary pole. Its use adds to the height of the lamp from the ground, and thus materially increases the area of perfect illumination, and also decreases the area of shadow projected from the cross-arm and the top of the pole.

The cross-arm on the pole is also used as a step, upon which the trimmer may stand when doing his work. The iron band attached to the bottom of the frame forms a substantial railing, within which the trimmer may safely work, using both hands, even during high winds.

To the casting at the top of the frame is secured a switch-board, upon which the hangings for the lamp are attached. The swinging of the lamp and its wires are prevented by the use of clamps attached to the side rods of the frame. The lower bar of the frame is screwed upon the top of a tubular post, which is secured to the top of the wooden pole by means of hook bolts.

The reflector, shown attached upon the side rods of the pole top, consists of a series of ten or more radial plates of French glass of the proper curvature and heavily plated with pure silver. The durability of these reflecting surfaces is insured by the use of a process of backing, which renders them impervious to dampness. The glass plates are set in metallic cases and mounted on rings, which permit their adjustment to any desired vertical angle. The rings are attached to the side rods of the pole top by means of suitable clamps operated by thumbscrews. This arrangement for the support of the reflector upon the pole top, instead of the lamp, permits the removal and replacing of the lamp at any time without disturbing the reflector.

In the use of reflectors on arc lamps the primary object is to illuminate more brilliantly the area directly under the lamp and thus render the general lighting of the street or other area more uniform. This object is fully secured by the use of this reflector, which arrests the light which would otherwise pass out into the upper space and sends it back to earth to be used where it will do the most good.

Standing directly under a lamp provided with one of these reflectors, the effect is as if the arc lamp was surrounded by a belt of ten incandescent lamps. The power of the reflecting surfaces is calculated to give the best possible general results at all times during the burning of the carbons.

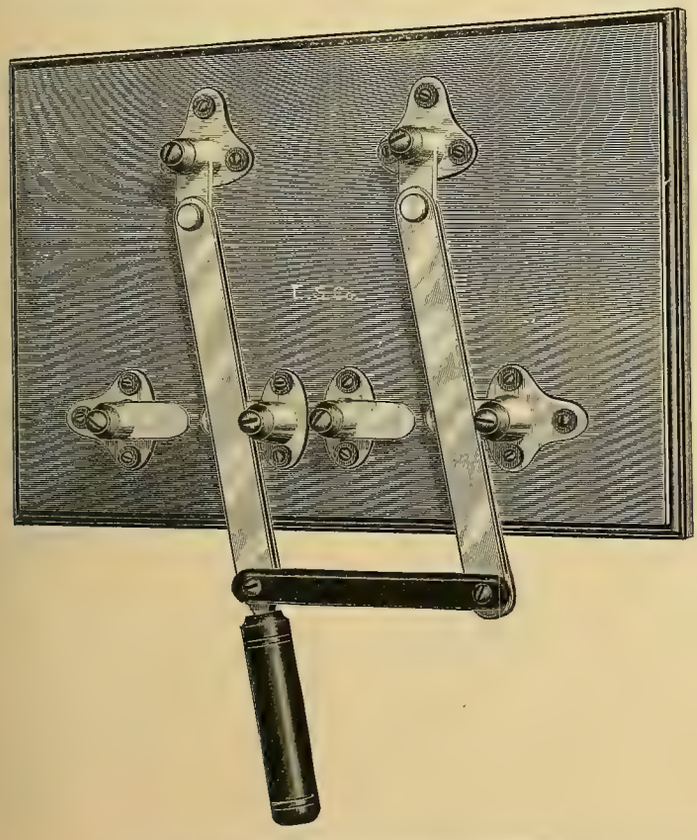


Fig. 1.—Double Strap Switch for Arc Circuits.

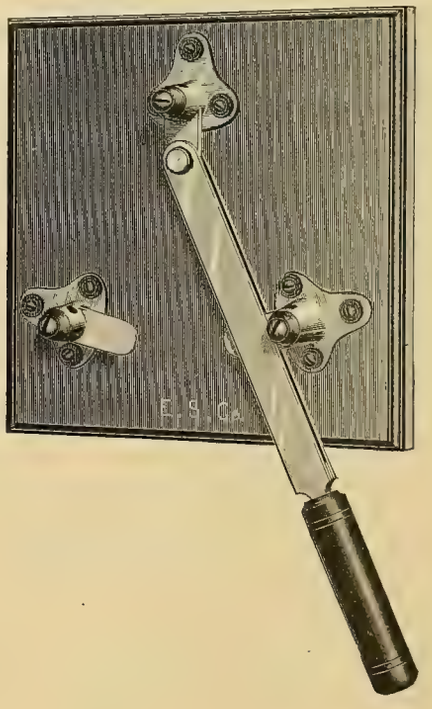


Fig. 2.—Single Strap Switch for Arc Circuits.

A Wooden Conduit on Fire.

Leading out in Market street from the station of the Chicago Arc Light & Power company, located at the corner of that and Washington streets, Chicago, was a creosoted wooden conduit containing arc mains. The conduit was in the form of long boxes, about four inches by four inches square, and in all there were twelve boxes, ten of which contained arc light cables, each of which had six conductors. A week ago Sunday night, the insulation became destroyed, and the conduit was set on fire. The next day steps were taken to locate the fault, and the frozen street was dug up. The location of the fire was soon discovered, but smoke was still seen coming from the conduit. On the assumption that this smoke had only worked its way the length of the section of conduit, a blower was attached to expel the smoke; but the longer the blower was worked the more dense the smoke became, and it became evident that the fire had worked its way a considerable distance into the conduit. Then recourse was had to a chemical extinguisher of the fire department, and with the aid of this apparatus, the fire was effectually quenched. Laborers were set at work to excavate the solidly frozen ground, and a thorough investigation begun. It was found that about twenty feet of the section of conduit had been burned out, necessitating the removal of the entire seetion, 110 feet in length. It is needless to add that the whole section was replaced with iron pipes.

Water-Soaked Dynamos Dried by Steam.

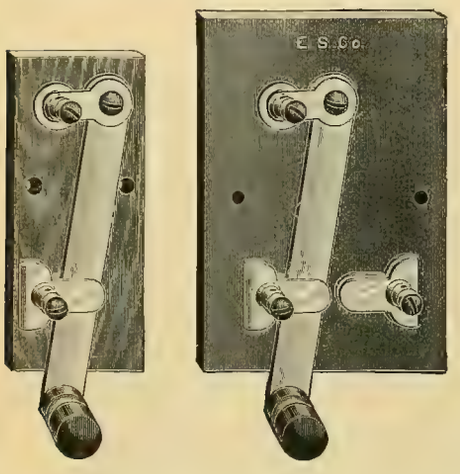
A few weeks ago, as noted in these columns, the station of the Brush company at St. Louis, was badly damaged by fire. When the fire department left the place the dynamos were standing deep in water. Notwithstanding the difficulties in the way, the most active and energetic measures were taken to get the station in running order again. The water was drained away and then a steam radiator was placed either side of each dynamo and a tarpaulin thrown over the top, making as it were an oven for each dy-

namo. Steam was then turned on and for sixteen hours the dynamos were subjected to the heat. At the end of that time the dynamos were found to be thoroughly dried out and in condition to use again. Seven of the dynamos were found in perfect order and only one was found to be slightly damaged.

Execution by Electricity.

The commission appointed by the legislature of New York two years ago to report on the most humane and practical method of carrying into effect the death sentence, and consisting of Elbridge T. Gerry, Alfred P. Southwick, and Matthew Hall, made its report on the 16th inst., and, as was expected, has unanimously recommended the electric method. The report reviews every conceivable scheme of putting to death, from the days of Moses and the early Chinese down to the bow stringing of the Turks, the guillotining of the French, the garroting of the Spaniards and the barbarous strangulation of the present American system. A more remarkable collection of horrors could hardly be presented. It reminds the reader of thrilling chapters from Lamartine, and the more morbid recitals of the Newgate calendar. All argument tends to discontinue the hideous gallows now in vogue.

We are led to wonder, runs the report, if the time will ever arrive when the gallows shall be placed as a curiosity in museums, and sightseers shall flock to gaze upon it, and marvel how a people who gave evidence of so much civilization and refinement as did their forefathers —we shall be forefathers then—could have



Figs. 4 and 5. — Switches for Incandescent Circuits.

employed such a machine for the amelioration of the moral condition of mankind. Will posterity shudder at a model of a gallows set up in complete working order on a shelf, as we of to-day shudder when we examine the ancient instruments of torture collected in the old world museums? Will the American of the year of our Lord 2000 be so far in advance of us? We venture to hope so.

A summary of the methods in use in seventeen different European countries shows that eleven use decapitation, seven the guillotine, and four the ax or sword; two use the musket, three the gallows and one, Spain, the garrote; the methods in some of these countries being varied. In twelve, executions are public, and in five private.

The following facts are disclosed:

1. That the effort to diminish the increase of crime by the indiscriminate application of capital punishment to various offences involving different grades of moral turpitude, or, in other words, by the enlarging of the number of offences to which capital punishment is made applicable, has proved a failure.

2. That any undue or peculiar severity in the mode of inflicting the death penalty, neither operates to lessen the occurrence of the offence, nor to produce a deterrent effect.

3. That from the long catalogue of various methods of punishment adopted by various nations at different times, only five are now practically resorted to by the civilized world.

The report continues: Perhaps the most potent agent known for the destruction of human life is electricity. Death, as a result, is instantaneous upon its application. The application may be made without the slightest injury to the officers, charged therewith, the place for its infliction may be strictly private, and at the same time its certainty is beyond a doubt. It is the duty of society to utilize for its benefit the advantages and facilities which science has uncovered to its view. One objection urged against the use of electricity is the shock which the lay mind is prone to think must, of necessity, be incidental to its use. Even if a shock were experienced, it is difficult to understand how it could be as objectionable as the dropping from the scaffold in the method which now obtains. But an electric shock of sufficient force to produce death cannot, in fact, produce a sensation which can be recognized.

The velocity of the electric current is so great that the brain is paralyzed; is, indeed, dead before the nerves can communicate any sense of shock. Professor Helmholtz estimates the interval necessary for nerve communication with the brain at one-tenth of a second. Professor Tyndal estimates that an electric discharge occurs in one hundred thousandth of a second, or ten thousand times more rapidly than nerve transmission.

From the observation of Dr. Fell, of Buffalo, Professor Thompson, Thomas A. Edison and others, the following deductions may be drawn:

"*First*—That death produced by a sufficiently powerful electric current is the most rapid and humane produced by any agent at our command.

"*Second*—That resuscitation after the passage of such a current through the body and functional centers of the brain is impossible.

"*Third*—That the apparatus to be used should be arranged to permit the current to pass through the centers of function and intelligence in the brain."

"Your commission are satisfied that the appliances for an execution by electricity can be made extremely simple. All that would be essential would be a chair, with a head and foot rest, in which the condemned could be seated in a semi-reclining position. One electrode would be connected with the head rest and the other with the foot rest, which would consist of a metal plate. The expense of such a chair would not exceed $50. If the current of electricity is supplied from the electric light wires there would be but slight expense necessarily incurred to make the connection from the chair with the wires on the outside. If, however, it is deemed best to have an independent wire running directly from the electric light plant to the place of execution, there would be the additional expense of constructing an independent line for that purpose, which would depend somewhat on the length of the line, varying from $250 to $500. If, however, it is deemed best to have an independent appliance, consisting of an alternating machine, or such a machine at that suggested by Professor Thompson, which would furnish an electric current of sufficient power, entirely independent of any outside communication, the expense would be between $250 and $500."

The cost of maintainance of either of the foregoing plans would be merely nominal. After the plant is once established the expense of conducting an execution would be infinitesimal.

After explaining in detail the many advantages and the humanity of employing the electric spark to destroy the "lives forfeited to the state" the report concludes thus:

"Your commission respectfully present the folpwing recommendations:—

"*First*—That the present method of inflicting the death penalty be abolished, and, as a substitute, that a current of electricity, of sufficient intensity to destroy life instantaneously, be passed through the body of the convict.

"*Second*—That every such execution take place in a state prison, to be designated by the court in its judgment and death warrant, and that the time of the execution be not fixed by the court, except by designating a period within which it must take place.

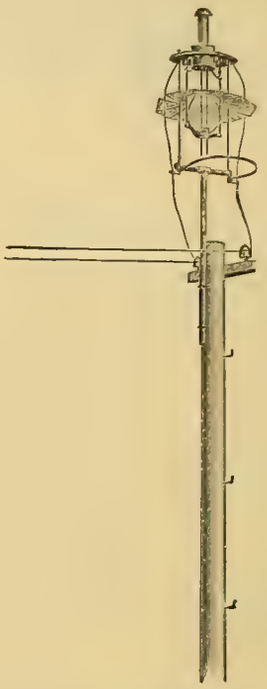


Fig. 3.—Pole Top and Reflector.

"*Third*—That immediately after the execution, a post mortem examination of the body be made by the physicians present, and the remains be then handed over to the medical profession for further dissection, or be buried without ceremony in the prison cemetery or graveyard, with sufficient quicklime to insure their immediate consumption.

"*Fourth*—That the public accounts of the execution be limited as regards its details."

William D. Howells thus discusses the subject in *Harper's Weekly:* At this season, when every influence and association reminds us of one who died that mercy might live forever in the wills of men, I have been peculiarly interested in the newspaper discussion of the proposition for the substitution of death by electricity for death by hanging in the infliction of capital punishment. It appears that a measure of this kind is to be brought forward in the New York legislature during the winter, and that there is reasonable hope of its adoption, though I observe that there is a great deal of affectionate regard for the good old gallows-tree among the publicists of the press. In fact, there is much to be said in behalf of this venerable growth of centuries, rooted in the remotest past of our Anglo-Saxon race, and hardly surviving the ax and the stake through every change of polity and religion. Yet there is grave question whether it is not an instrument of torture as well as of death, and whether it is not our duty, after nearly nineteen centuries of the Christ who bade us not to kill at all, to kill by the humanest method known to science. The weight of learned testimony seems to be in favor of electricity, and there is apparently no good reason why this mysterious agent, which now unites the whole civilized world by nerves of keen intelligence, which illuminates every enterprising city, which already propels trains of cars and promises to heat them, which

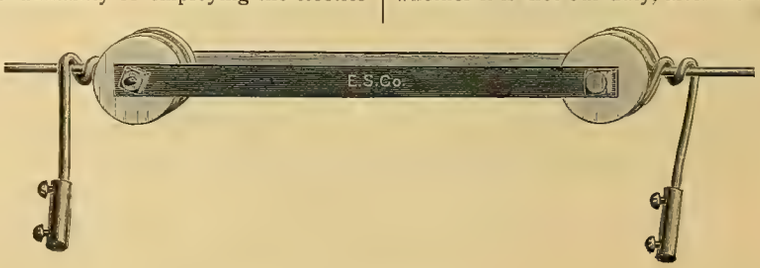
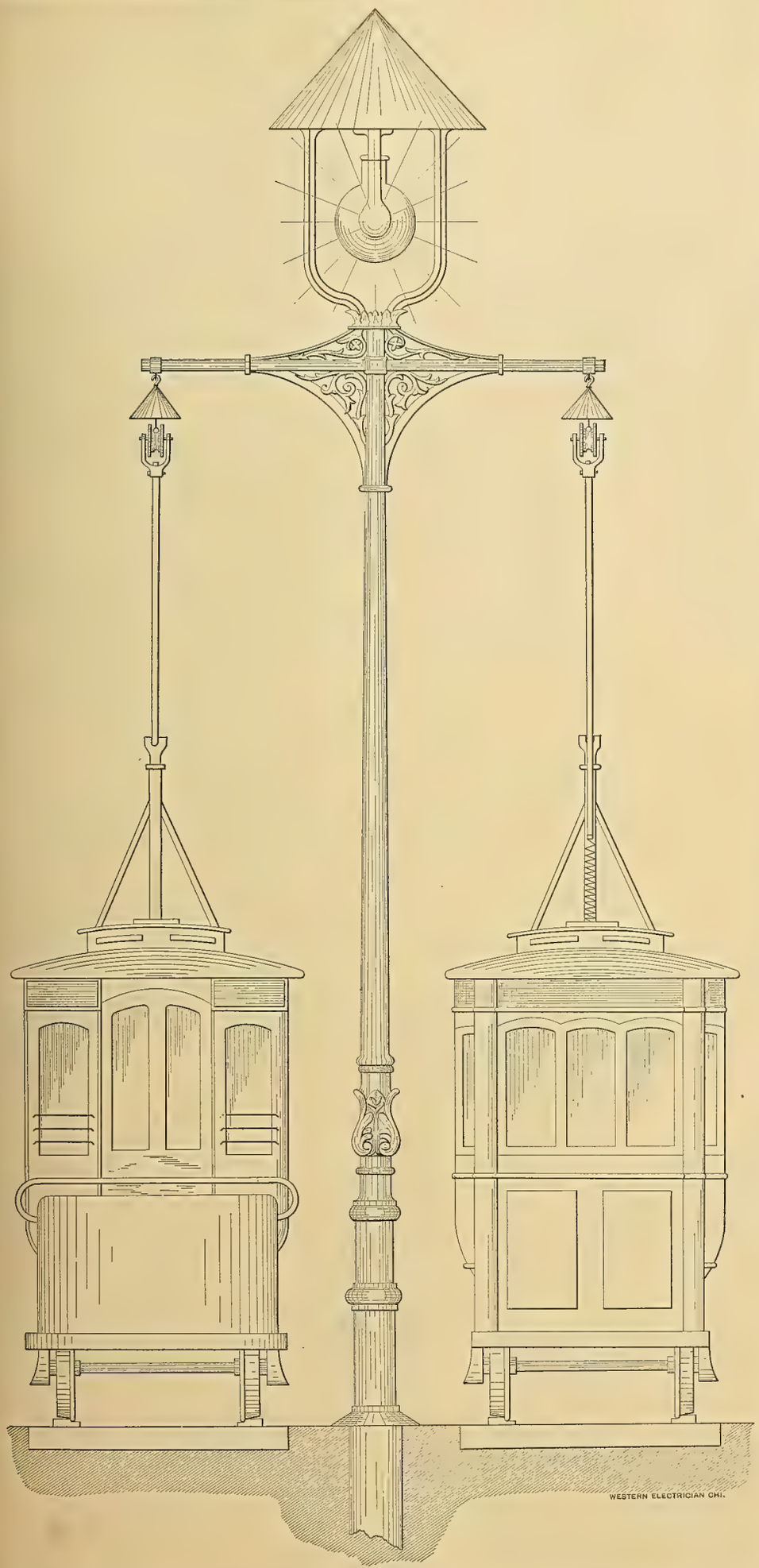


Fig. 6.—Circuit Loop Iron.



has added to life in apparently inexhaustible variety, should not also be employed to take it away.

There is a sort of poetical fitness in its use which we ought not to overlook in an age and a country ambitious of amenity as well as humanity. I understand that the death-spark can be applied with a minimum of official intervention, and without even arousing the victim, or say patient, from his sleep on the morning fixed for the execution of the sentence. One journal has drawn an interesting picture of the simple process, and I have fancied the executions throughout the state taking place from the governor's office, where his private secretary, or the governor himself, might touch a little annunciator button and dismiss a murderer to the presence of his maker with the lightest pressure of the finger. In cases of unusual interest the executive might invite a company of distinguished persons to be present, and might ask some lady of the party to touch the button. Or, as when torpedoes are exploded or mining blasts fired in the completion of a great public work, a little child might be allowed to discharge the exemplary office.

In the event, however, that the legislature should refuse to touch a single bough of the honored tree which has so long sheltered Anglo-Saxon society, I have a suggestion to make in this matter of executions. I have long thought it cruel to the sheriff and his deputies to force them to this hangman's work, and monstrous to let some imbruted wretch make legal killing his trade; and I have to propose that the executioner should be drawn from a society at large as jurors are, and that no excuse should avail, except the oath of the person drawn that he is conscientiously opposed to capital punishment. This system, which is perfectly practicable, would give from time to time, men of every profession and station the opportunity to attest their devotion to the great principle that if it is wrong to take life, a second wrong of the kind dresses the balance and makes it right.

A New Design for Overhead Transmission.

For street cars propelled by electricity, on streets broad enough to allow the tracks to be laid in the center, with sufficient space between the two lines of rails, a neater design than that shown in the accompanying cut for a system of overhead transmission could not well be devised. The design is to be credited to the Van Depoele Electric Manufacturing company of Chicago.

There are many features about the design that will impress themselves upon the reader as meritorious and not the least of these is the facility it offers for the electric lighting of the street in conjunction with the transmission of the current to the motors on the cars. Incandescent lamps can be mounted on the poles and from their location in the middle of the street can illuminate it in a much more thorough manner than when placed at the side and are more readily accessible than those extended on arms toward the center of the street from poles erected at the edge of a sidewalk.

Transmission of Power by Electricity.[1]

By Prof. H. S. Carhart.

1. Generators for supplying a power current may be divided into four classes: 1. Constant potential or e. m. f. machines; 2. constant current machines; 3. machines to furnish a constant amount of power at the motor; 4. alternating current machines. It is proposed to explain some points in the transmission of power under these several conditions.

2. Given E and R to find C and *maximum* W′, where E, R and C are used with the ordinary signification and W′ denotes the work delivered by the motor. It is well known that the energy of an electric current is found by multiplying together the current and the e. m. f.; and if this product be divided by 746, the rate of working is expressed in horse power. When a motor is in circuit this energy is divided into two portions, one going to heat the conductor, the other being converted into mechanical work. Expressed in the form of an equation,

(1). $CE = C^2R + W'$. If this equation is differentiated we obtain

$\frac{dW'}{dC} = E - 2CR = 0$ for a *maximum*, since the second differential coefficient is negative. Therefore $E = 2\,C\,R$ or $C = \frac{1}{2}\frac{E}{R}$ Under these conditions we have, not maximum efficiency, but what is known as Jacobi's law of maximum activity. The amount of power transmitted is a maximum when the current is reduced to half the value it would have with the motor at rest. This reduction in the value of the current

1 Read before the Engineering Society of the University of Michigan.

is due to a counter e. m. f. set up by the electromagnetic reactions of the motor. The resistance or opposition which the machine offers to the energy of the current which drives it is manifested as this counter e. m. f. And since the current suffers a reduction of one-half its volume, the effective e. m. f. is reduced to one-half, the resistance being a constant; or in other words, the counter e. m. f. E′ equals ½ E for maximum activity. In general then

$C = \frac{E - E'}{R}$; $W = \frac{E(E - E')}{R}$ (or E C);

$W' = \frac{E'(E - E')}{R}$ (or E′ C). Efficiency is the ratio of the work done by the motor to the work spent upon the generator. Measured electrically it is $\frac{W'}{W} = \frac{E'}{E}$. For maximum activity the electrical efficiency is only one-half; or, considering only the electrical transformations, one-half the power is wasted in heating the conductor. By conductor is meant the entire electrical circuit. The loss is actually greater than one-half because of friction, Foucault currents, and perhaps some other small losses. In this case the only way in which the efficiency can be increased is to increase the counter e. m. f. This means, of course, a smaller current, and a slower rate of doing work. The motor will produce a higher back e. m. f. if it runs at a higher speed and so, of course, under a lighter load.

3. Given C and R to find conditions of greatest efficiency. If C and R are constants then $\frac{E - E'}{R}$, the value of the current, is a constant; also E – E′ is a constant. With this difference of the electromotive forces in the two directions a constant, both W and W′ will increase with the e. m. f's. employed; but E′ will increase more rapidly than E. Hence the quotient of E′ and E or the efficiency will increase. Or otherwise, if C and R are constants, C^2R which represents the heat waste, is also a constant. If the waste in heat is a constant, of course, the efficiency increases with E or with the work done in driving the generator. Electrically all the energy spent in securing higher e. m. f's. is pure gain, since the conversion into heat remains constant on account of the constancy of the current. This applies only to a constant current machine.

4. It will be seen that a constant potential dynamo as generator and the motor working in connection with it should both be built so large that they may do the necessary work when the motor runs rapidly under a light load. The economical limit to the size and capacity will be reached when the interest and depreciation of the plant equals the loss in heating the electrical conductor. It is perhaps not necessary to say that the e. m. f. should be as high as the conditions will permit. The generator will not work up to its maximum capacity, but power will be transmitted with the least loss or with greatest efficiency.

With a constant current dynamo as generator the case is different. The machine should be run so as to generate its highest permissible e. m. f., and thus transmit through the conductor to the motor the largest amount of energy. If the motor is so designed that its e. m. f. rises simultaneously with that of the generator, so as to maintain a constant current, an electrical combination of the highest efficiency will be secured.

5. Given W′ and R to find C and *minimum* E. If a given amount of power is to be transmitted to a motor through a known resistance, then there is a lower limit to the e. m. f. of the generator below which it will be impossible to transmit the required power. This may be shown by the following method. The work done by the motor has already been expressed as the product of the current and the back e. m. f. it produces; or

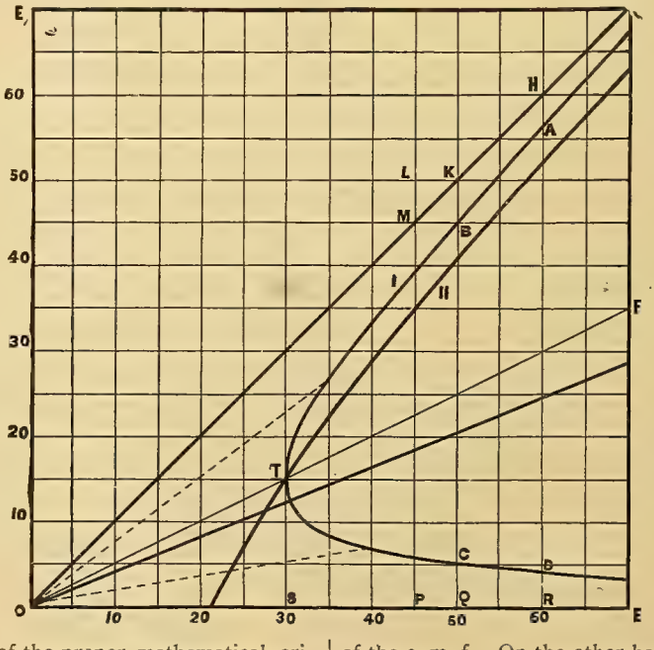
(2). $W' = \frac{E'(E - E')}{R}$. If now both W′ and R are constants, then E′(E – E′) is likewise a constant. But when the product of two factors is a constant their sum is a minimum when they are equal to each other. But their sum, E′ + (E – E′) is E; and this therefore is a minimum when E′ equals E – E′, that is, when E′ equals ½ E. This corresponds to Jacobi's law of maximum activity. Since in both cases e. m. f. and work done at the motor are two quantities separated as widely as possible, it is plain that the condition attaching to maximum power transmitted with a fixed e. m. f. of the generator will also apply to the case of minimum E with a fixed amount of power to be recovered. This condition is that the counter e. m. f. shall be half the direct.

By substitution in equation (2) we find $E = 2\sqrt{R\,W'}$ and $C = \sqrt{\frac{W'}{R}}$. From these equations it follows easily that the efficiency measured electrically is one-half.

The smallest e. m. f. at the generator which will enable the electrical combination to do the required amount of work at the motor varies as the square root of the resistance in circuit. Any reduction of e. m. f. can thus be secured only at the expense of a much greater reduction of resistance. A reduction of the direct e. m. f. one-half requires reduction of resistance to one-quarter. On the contrary doubling the e. m. f. will permit of increasing resistance fourfold. In the attempt to transmit a large amount of power obstacles are encountered in the difficulty of securing the necessary insulation for high e. m. f. in the one direction, and the expense attending very low resistances in the other.

6. It may be interesting to trace the varying relation between E and E′, when the motor is running under a constant load, by means of a graphical method. [See diagram.] Equation (2) gives

(3.) $E'^2 - EE' = -RW'$, an equation of the second degree and therefore of a conic section.



The application of the proper mathematical criterion proves that the equation represents an hyperbola. This hyperbola is a graphical representation of the continuously varying relation between E and E′. If we solve the equation for E′ and substitute in the resulting expression successive values of E, every value of E will give two positive values of E′ which satisfy the equation. The hyperbola is plotted by making the assumed values of E abscissas and the corresponding values of E′ ordinates. Every value of E thus gives two points of the curve.

By comparison with the most general equation of a conic section the constants of this hyperbola may be obtained; and it is thus found that the angle between the axis of abscissas and the axis of the curves is 22° 30′, and that the axis of abscissas and the diagonal of the figure are the asymptotes. The angle between them is then 45°. The characteristics of the curve may thus be determined without a knowledge of the constants R and W′. But to draw a curve some value of R W′ must be assumed. The value assumed for the figure was 225, making minimum E equal to 30.

A number of inferences can be drawn directly from the curve:

a. E is seen to be a minimum when it is double E′. At this point the hyperbola is tangent to an ordinate. The point of tangency will travel along the line OF as RW′ increases. The line OF is therefore the line of minimum E.

b. The electrical efficiency at any point of the curve, being the quotient of E′ by E, is the tangent of the angle between a line drawn from the point to the origin O and the axis of abscissas. Thus the efficiency at T is tan. TOE which is one-half.

c. The efficiency increases from zero when E′ is zero and E is theoretically infinite, to unity when E′ and E are both infinite. These extreme limits correspond to the points where the hyperbola touches its asymptotes.

d. It is also evident that near the point where E is a minimum, E′ increases most rapidly. The efficiency has the largest increments when its value is one-half. Beyond an electrical efficiency of about 70 per cent. any increase is decidedly uphill work. It is no great credit to an electrical engineer that his power plant shows an efficiency of 50 per cent. It is no task to make a dynamo that will work fairly well, and a motor is constructed on substantially the same principles; but to run up this steep grade of rising efficiency is a problem difficult enough for the most exalted talent to undertake.

e. The diagram shows further that E′ and C pass through a corresponding series of values but in the inverse order. The current is a maximum when the counter e. m. f. is a minimum and diminishes continuously as the efficiency increases.

If a shunt wound dynamo were employed its speed would fall from the largest practicable value of the current till the minimum e. m. f. were reached, when it must again rise with rise of the e. m. f. On the other hand the speed of the motor would rise continuously from the first, the work done remaining constant. The motor should therefore be large enough to do the work while running rapidly under a light load. If its field were separately excited the theoretical conditions would be more readily met.

7. Prof. S. P. Thompson says in his "Dynamo-Electric Machinery" that "for purposes of supplying motors alternate current machines are quite out of the question." But that statement was made with the knowledge of electrical engineering obtaining three or four years ago. Quite recently Mr. Swinburne said respecting the testing of alternate current motors that there are none such to test. It is nevertheless true that motors with a constant magnetic field have been run with alternating currents. Such is the case with two dynamos in multiple arc, one acting as generator and maintaining the other in synchronism as a motor. Two or three years ago Dr. Hopkinson first rigidly clamped together the armatures of his two machines, but subsequently found that the synchronism was maintained equally well when he simply connected the two machines in multiple arc. The synchronism was not affected even by throwing off the belt of one machine.

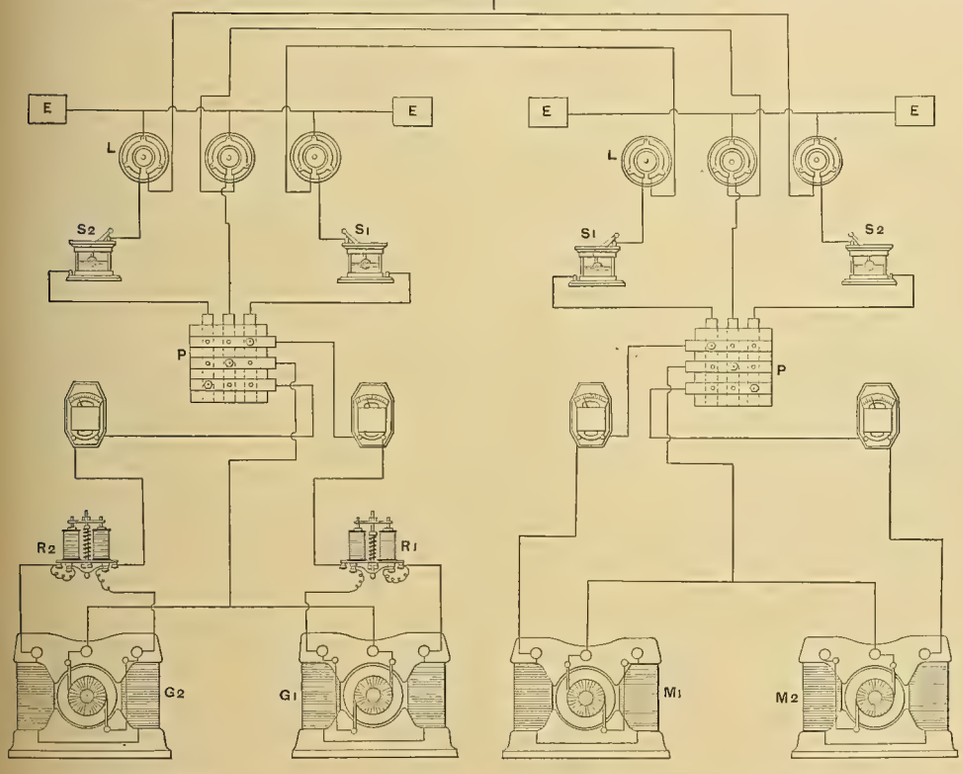
Self-exciting alternate current dynamos have been run in the same manner. In that case the

currents through the field are all maintained in the same direction by a commutator, but they fall to zero with every alternation. In this case too they are said to have maintained synchronism, one running as generator and the other as motor. It is difficult to see how much work could have been done under these conditions.

The rapid introduction of alternate current dynamos for incandescent lighting makes the question of alternate current motors one of live interest. Evidently the problems involved await solution.

Electric Transmission of Energy.[1]

In our issue of April 8, 1887, we give an account of experiments carried out at the Oerlikon Engineering works with a plant of two dynamos and two motors intended for the transmission of energy from Kriegstetten to Solothurn. These experiments were made by a committee of engineers and scientific men, with a view to ascertain the total commercial efficiency of the transmission plant; but as the machines were in this case placed side by side, the results could only be taken as approximately correct. It is evident that, in such an arrangement of machines and resistances erected within the limits of a covered workshop, the insulation of the circuit presents no difficulty whatever, whereas in the actual installation, when many miles of overhead wires must be used, the insulation becomes a matter of some difficulty, and atmospheric influences may also have some effect upon the performance of the plant. These considerations induced the makers to arrange for some further trials with the plant as actually installed. A committee was appointed, under the presidency of Professor Amsler, of Schaffhausen, the well known inventor of the planimeter, and the following gentlemen were members: Professor Weber, of the Zürich Polytechnic school, and his two assistants; Professor Hagenbach Bischoff, of Basle; Professor Veith, who occupies the chair of machine construction at the Zürich Polytechnic school; Herr Keller, engineer to Messrs. Escherwyss, of Zürich; Herr Lang, a manufacturer of Derendingen; and Herr E. Bürgin, of Basle, the inventor of the Bürgin dynamo. This committee have just issued their official report on the trials made on the 11th and 12th of October last with the plant as actually installed. Before quoting the results of these trials, it will be well to briefly refer to the general arrangement of this installation. At Kriegstetten there is a water power available, representing about forty actual horse power, and the problem was to carry as much of this power as possible to a mill in Solothurn, the distance being 4¾ miles as the crow flies; but, allowing for deviations, the length of each circuit may be taken as about five miles. There are at Kriegstetten two generating dynamos, and at Solothurn two motors, coupled up on the three-wire system, as shown in the illustration. Each dynamo weighs 3 tons 12 hundred weight, and has a Gramme armature 20 inches diameter and 14 inches long, the normal speed being 700 revolutions per minute. Referring to the diagram of connections, G_1 and G_2 are the generators at Kriegstetten, and M_1 and M_2 are the motors at Solothurn. R_1 and R_2 are electro-magnetic switches which automatically come into action and short circuit the exciting coils in case of the current rising beyond a certain limit. This provision was introduced in order to guard against the destruction of the generator in case a short circuit should take place somewhere in the line. The current from each of the generators passes through an ammeter and then to a plug board, to which is also connected the balancing wire joining the negative brush of G_2 with the positive brush of G_1. The balancing wire is then carried direct to the middle one of the three lightning arresters L, and then to the middle wire of the line, whilst each of the outside wires is led through a liquid switch S_1 S_2, then to a lightning arrester, and to the line. Each lightning arrester consists of a circular metal disk, the edge of which is provided with projecting teeth, and situated in a concentric metal ring, the internal circumference of which is also provided with teeth, but not touching the teeth of the disk. All the disks are connected with a common earth wire and two earth plates EE. Should a flash of lightning strike the line, the current will leap across the intervening space between the teeth of the ring and those of the disk, and will thus be led to earth without passing through the machinery. The same provision against lightning is made at the motor station. The switches S_1 S_2 are of peculiar construction, and consist of a vessel containing a conducting liquid and a perforated metal ball dipping into it. When the current is to be switched off, the handle is turned so as to raise the ball out of the liquid; but the circuit is not immediately interrupted, since the liquids within the balls issues in fine streams out of the perforations, and so maintains the connection for a short time after switching off. As the liquid in the ball gets exhausted, and the streams become thinner, the resistance of liquid connection is gradually increased to infinity, and thus causes the current to gradually diminish to zero. The line wires are supported on Johnson & Philips' patent fluid insulators, and the average span is about 130 feet. Two sets of experiments were made. On October 11th only one generator and one motor were tested, while on October 12th both generators and both motors were tested. In the latter test the balancing wire was cut out of circuit as of no importance when, as in these experiments, it was quite easy to regulate the load of each motor so as to fairly divide the work between them.



KRIEGSTETTEN. SOLOTHURN.

Electrical measuring instruments were fitted up at both stations in rooms sufficiently distant from the machinery, so as not to be influenced by stray magnetism. The current was measured by large tangent galvanometers, and Thomson mirror galvanometers, standard cells, and potentiometers were used to measure the pressure. The object in measuring the current at both ends of the line was to ascertain whether any appreciable leak took place. In addition to these purely electrical measurements, observations were made at the generator station regarding the water level in the head and tail race of the turbine, the position of the regulator on the latter, and the speed of the dynamos and turbine.

The following tables give the results as published by the committee:

I.—ELECTRICAL MEASUREMENTS.

Time of trial.	Electromotive force.		Terminal pressure.		Current measured at	
	Generators.	Motors.	Generators.	Motors.	Generators.	Motors.
Oct. 11.	1231.6	988.6	1177.7	1041.2	14.20	14.17
Oct. 11	1237.0	1016.8	1186.8	1066.1	13.24	13.28
Oct. 12.	1836.5	1575.4	1753.3	1656.1	11.48	11.42
Oct. 12	2129.0	1896.2	2058.0	1965.2	9.78	9.79

II.—RESISTANCES AND LOSS OF PRESSURE.

Time of trial.	Resistance of machines.		Line resistance.	Pressure lost in liae.		Temperature of air, Centigrade.
	Generators.	Motors.		Calculated.	Measured.	
Oct. 11.	3.741	3.716	9.228	130.9	136.5	+7.5
Oct. 11.	3.741	3.710	9.228	122.3	120.7	+7.5
Oct. 12.	7.251	7.060	9.044	103.7	97.2	+3.2
Oct. 12.	7.240	7.042	9.040	88.4	92.8	+3.2

III.—DETERMINATION OF ENERGY.

Time of trial.	Internal electrical horse power.		Terminal electrical horse power.		Actual horse power	
	Generators.	Motors.	Generators.	Motors.	Supplied to generators.	Obtained from motors.
Oct. 11.	23.76	19.03	22.72	20.02	26.15	17.85
Oct. 11.	22.27	18.34	21.35	19.23	24.54	16.74
Oct. 12.	28.64	24.46	27.34	25.71	30.87	23.21
Oct. 12.	28.29	25.21	27.37	26.13	30.87	23.05

IV.—PERCENTAGE OF EFFICIENCIES.

Time of trial.	Electrical efficiency.		Commercial efficiency.		Total efficiency of transmission.	Remarks.
	Generators.	Motors.	Generators.	Motors.		
Oct. 11.	90.8	93.7	86.8	89.1	68.3	One generator and one motor.
Oct. 11.	90.6	91.3	86.9	87.1	68.2	
Oct. 12.	92.8	94.8	88.5	90.3	75.2	Both generators and both motors.
Oct. 12.	91.6	91.4	88.7	88.2	74.6	

An inspection of these figures will show that there is practically no loss of current by leakage on the line. In some cases the current measured at the motor station is slightly below that measured at the generator station; but the discrepancy is exceedingly small, and evidently due to personal or instrument errors, since in some other cases the current received by the motors appears to be even slightly larger than that sent out by the generators, which is obviously impossible. The second table also shows the influence of the air temperature upon the total resistance. The third table gives the power, and the fourth the efficiencies in percentages. It will be noticed that when one generator and one motor only were used, the commercial efficiency was slightly over 68 per cent.; but when both generators and both motors were used, this efficiency rose to about 75 per cent., which is clearly due to the higher voltage employed. On the whole, the result of these trials must be considered highly satisfactory.

1 *Industries* January 6th.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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THE stock exchange in New York has come out against the bucket shops, and a fund of $10,000 is to be established to carry on the warfare.

THE copper market is characterized by a continued firmness, and the prospect is that a return to the low prices of a few months ago is a thing of the distant future.

EVEN the ancient city of Rome proudly points to its electric light, which now illuminates the very streets that in Nero's time were illumined by the blaze that was consuming the city.

THE committee on fire and water of the city council of Chicago have recommended the adoption of the mayor's suggestion regarding the lighting of the river to Ashland avenue on the south and Fullerton avenue on the north by electricity. Most of the committee seem disposed to also favor the extension of the system for street lighting.

THE subject of a government telegraph is ably discussed in our columns this week, in the reports of the addresses of Dr. Norvin Green, president of the Western Union Telegraph company, and Gardiner Hubbard before the United States senate post office committee and the addresses of F. B. Thurber and Erastus Wiman before the National Board of Trade.

DECEMBER 31st, we referred in an editorial, to the appointment of a commission, by the New York legislature, to report during the present session, on the subject of executions. In another column will be found a summary of the report which was presented on the 16th inst., from which it appears that electricity is the mode recommended as being the most rapid, most merciful, most in accordance with the scientific progress of the age, the least objectionable in its attendant circumstances, and the most efficacious in its moral effect on the average criminal as a deterrent to the commission of crime. It is also recommended that no special day be fixed for the execution, but a definite period within which it must take place; that the body be given for dissection, or buried in the prison cemetery, and the publication of details limited.

We also publish an article on the same subject by W. D. Howells, recommending the electric method, and suggesting, among other reasons for abolishing hanging, that it is cruel and barbarous to require the sheriff to act as hangman, or to employ a professional hangman.

It is unfortunate that while such action is being taken in favor of making executions more merciful, there seems to be no way of alleviating the horrors of murder, the crime being often so atrocious that there seems to be no punishment sufficiently adequate.

THE old adage, that there are always two sides to a question is well illustrated by the article from the Chicago *Daily News* on the telephone management in this city, which we reproduce in this issue, from which it appears that the complaints by other city papers that the employes spend their time in "buzzing," and novel reading, to the neglect of their business, are wholly without foundation.

It is very evident that a girl with twenty-eight telephones to attend to can find but little time for novel reading, and the opportunities for "buzzing" through the telephone with some dude, while subscribers are waiting, are not very brilliant with the manager's ear at a detective telephone, listening to the soft nonsense.

The impatience and unreasonableness of the subscribers are largely responsible for the complaints about imperfect service. The telephone is a wonderful instrument and a great public convenience, but it still has many imperfections which time, experience and scientific skill must remedy; and the company is undoubtedly rendering the best service possible with the means at its command, and its employes are under as strict surveillance, and are themselves as anxious to render efficient service, as those of any other business establishment.

AT the First Congregational church in Chicago, last Sunday, the pastor, Dr. E. P. Goodwin, preached a very interesting and impressive sermon to the children, illustrated throughout by magnetism. With a horse-shoe magnet and a lot of nails, tacks, iron filings, bits of glass and coins, gold, silver, nickel and copper, he illustrated the influence of the gospel on people of various classes, giving in connection a simple scientific lecture on magnetism. A number of twenty-penny nails dressed up in various fantastic styles illustrated the votaries of wealth, pleasure and worldly gain. The real estate man was symbolized by a big nail enclosed in putty, through which the magnetic influence could not penetrate; the devotee of pleasure, wrapped in silk and tricked out with ribbons, was equally impervious to magnetic influence, while the big, fat nail, with luxurious wrappings and money-bags attached, could not be attracted even when the bags were detached, the sordid wrappings still remaining. The magnet utterly rejected the gold and silver, while the bare, rusty nails clung to it tenaciously; the filings, tacks and little nails, symbolizing the children, were attracted in great numbers, while the big, heavy spikes, symbolizing adults, were but slightly influenced. Magnetized nails attracted other nails, and these still others, but when connection with the magnet was severed the attraction ceased. But the hardened bits of glass had in them nothing which could respond in the slightest degree to magnetic influence, and symbolized those whose course of life had rendered them utterly impervious to gospel influence.

THE purification of water by electricity is the latest electric discovery. This is said to have been accomplished by two Pittsburg gentlemen, Professor Blanck and R. W. Smith. A patent has been applied for and details are for obvious reasons suppressed; but it is claimed that very remarkable results have been achieved; and that the destruction of all animal and vegetable life and the entire removal of every thing deleterious to health, can be successfully accomplished, resulting in the production of water absolutely pure.

It remains to be seen whether this can be accomplished on a sufficiently economical basis for general use. If so, it will be a great boon, as impure water is a fruitful cause of disease, and there is probably very little water in use which is even approximately pure. In the rural districts the water obtained from wells and springs is largely impregnated with mineral impurities, and is surface water filtered through strata of rock and soil, while the unfiltered surface water obtained from brooks and ponds is still more impure. In large cities the sewage is, in many cases a constant menace to the purity of the water, and wells in the vicinity of cemeteries, barnyards, and privy vaults are poisoned fountains.

Experiments with water impregnated with sewage are said to have resulted in its complete purification. The enterprise is said to have good financial backing. It may, however, be seriously doubted whether the electric purification of water can be accomplished on any such economic scale as to bring the process into general use.

"IF this should meet the eye of Mr. B. E. Sunny, of Chicago, we would invite him to consider the meaning of the word 'banter.' In America, as in England, it may be sometimes called chaff; but with us it can rarely be mistaken for a sneer. We have never sneered at Mr. Sunny, and, what is of more consequence, never at 'American achievements.' The editor of the WESTERN ELECTRICIAN, where Mr. Sunny accuses us of these offences, confesses that the facts as presented at the time in Mr. Sunny's paper on underground wires, were liable to be misunderstood. This was precisely our opinion; and in commenting on the paper we playfully pointed out where the misunderstanding would come in. That we were not able to export at the same time the requisite sense of humor for understanding us, is to be regretted; but it is an explosive commodity, that will not bear transmission through the post."

Our esteemed contemporary, the London *Electrician*, thus replies to the tart and racy answer of Mr. Sunny to the criticisms passed upon the latter's paper, in relation to Chicago underground work, by the former.

The WESTERN ELECTRICIAN has heretofore commented upon the uniformly courteous and fair treatment and respect accorded American electricians and American electrical achievements by the English electrical press, of which the London *Electrician* is an able exponent, and of which it is also one of the fairest and most courteous. But our contemporary's comments upon Mr. Sunny's paper struck us as widely departing from its usual spirit, and hence our reply. However, forewarned is forearmed, and we will read between the lines the next time for "chaff," for we will not find it in the lines, and will endeavor to cultivate a sense of humor, in which we seem to have been deficient.

WE publish in this issue an article from the pen of Professor Carhart on the transmission of power by electricity, in which the demonstrations are chiefly mathematical. Mathematics are absolutely essential to electric engineering, and it is fortunate that some minds are so constituted that the pursuit of dry, mathematical detail is a pleasure. To adapt electric apparatus to the demands of business its economic value must be accurately known, and can be ascertained only by the aid of mathematics, and the same is true of the value of mathematics in all scientific investigations. Mathematics is simply a short, comprehensive language by which the reasoning process is made more rapid, direct and accurate. But it must always remain subservient to the physical facts. It is the handmaid, not the mistress of science.

Among other points in the article is that of motors operated by alternating currents. This was once considered practically impossible, and very little is yet known on the subject, only that its practicability has been completely demonstrated.

We give also another article on the same subject from *Industries* in which the practical operation of electric transmission of power on long aerial conductors, exposed to atmospheric influences, was investigated by a committee of Swiss and German scientists. This is very different from short transmission under cover in a factory or warehouse, and requires careful insulation, lightning arresters, and other means of protection against accident. The actual amount of power recovered as compared with that generated by the turbines was made a matter of careful measurement, and the results are given in the tables. It is evident that in a system where water power is utilized, which would otherwise be wasted, the recovery of even a small percentage of power might be economical; and the case would not be parallel with that of the expensive generation of power by steam with subsequent similar transmission.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number xxvii.

Arc Light Carbons Continued.—It has already been shown that the arc light is derived from incandescent carbon and carbon vapor, also that in the process of manufacture various hydro-carbons are used both in the original composition and in the subsequent process of infiltration, after which the carbons are again baked at a high temperature; the object of the infiltration being to produce density, and of the subsequent baking to reduce the hydro-carbons to pure carbon by expelling the other constituents.

It is found that the intensity of the light is in the direct ratio of the temperature of the arc, and, since pure carbon requires for its volatilization the highest temperature of any known substance, it is evident that this intensity depends on the purity of the carbon, any remaining foreign substance becoming volatilized at a lower temperature, and interfering seriously with the intensity of the light. It is shown by the spectroscope that the whiteness and purity of the light depends, like its intensity, on the purity of the carbon; and it is also found that the resistance of the arc is in the same ratio; its resistance being at the maximum, and its conductivity at the minimum, with the maximum of purity in the carbon. The distance between the carbons, as will be shown hereafter, is regulated automatically by this resistance, being shortest when the resistance is greatest; and the consumption of the carbon is, at the same time, at the minimum. Hence it follows that the highest economy of consumption, and the best light is attained with the greatest purity of the carbon.

As the vapor resulting from the volatilization of foreign substances has higher conductivity than carbon vapor, there is often, with impure carbons, a sudden lengthening of the arc and reduction of the light, caused by the consumption of this foreign material, the carbons automatically adjusting themselves to the reduced resistance, and again returning to their normal distance and the light to its normal intensity and purity, when the foreign matter is consumed; the net result being a flickering unsteady light, varying from a short arc of intense brilliancy, to a long colored arc of perhaps one-fourth the brilliancy, and returning again to the intense white arc.

Another serious defect is the lack of homogeneousness of structure, even with purity of material; the density at the ends may vary materially from the density at the center, producing an irregular rate of consumption; or dense carbon may be infiltrated throughout with soft carbon, the soft carbon consuming more rapidly, producing numerous small craters, and leaving ridges of hard carbon, resulting in a noisy inconstant light. Carbons molded by side pressure are less liable to the first defect—difference between the density of the ends and center—than those molded by end pressure, and subsequently cut into lengths; and the latter method has been generally abandoned in favor of the former in American factories, as it was found impossible to apply end pressure with proper uniformity. Carbons with the cores injected into shells of greater density burn more rapidly in the center than at the edges, and hence the form of the crater is more perfect, and the liability to the second defect—small craters surrounded by hard ridges—is greatly reduced. This defect can also be overcome by proper care in the preparation of the paste.

Carbons require to be perfectly straight and cylindrical, and of perfectly uniform diameter from end to end; and those of the length required for the usual long periods of continuous consumption are liable to defects in one or more of these respects in the various processes of manufacture. Good contact with the carbon-holders and proper alignment of the two carbons is impossible with those of defective form, and such carbons are a constant source of annoyance, no matter how great their excellence as regards purity and density.

The electric resistance of the carbons is also a point of the highest importance, especially on a circuit having a large number of arc lamps in series; and here again the purity of the carbons become important, for while the resistance of the incandescent vapor which constitutes the arc increases with the purity of the carbon, as has been shown, the resistance of the carbons themselves diminishes; the purest and densest carbons having the lowest resistance. Plating with copper, iron, or nickel, for the purpose of reducing resistance, has been tried with varied success, also imbedding iron wire in the center of the carbons. The principal objection to copper plating is, that with the constant current, the carbon of the negative rod is consumed more rapidly than the copper, leaving a copper fringe which casts a shadow; but, notwithstanding this objection, it is generally adopted as the best means of reducing resistance. Carbons for lights not exceeding 1,200 candle power do not require plating, while those for lights of 2,000 candle power and upwards are always plated.

The ordinary length of carbons, as already stated, is 12 inches, but the diameter varies according to the strength of current and candle power of the light for which the carbons are intended, ranging from $\frac{7}{16}$ inch with a 6.8 ampere current, and a 1,200 candle power light to $\frac{9}{16}$ inch, with a 15 ampere current and a 3,000 candle power light. For a 2,000 candle power light with a 10 ampere current the diameter of the carbons is $\frac{7}{16}$ to $\frac{8}{16}$ inch, while for exceptionally powerful lights, such as are required for light houses, and search lights on steamers, carbons exceeding an inch in diameter are required.

The principle which underlies this is the ratio of molecular action to the mass of the carbon. If the mass is too small for the amount of current the molecular action is too much concentrated, and the carbon either wastes away by becoming heated through, from end to end, or there is an imperfect formation of the crater, the edges consuming too rapidly, allowing upward radiation and consequent practical loss of light. But if the mass is too large for the current, the molecular action is too much diffused, producing a dull red light in the outer portions of the carbons instead of an intense incandescent glow; the point of the lower carbon also becomes too obtuse, causing too great lateral radiation, and a broad shadow underneath. With the proper proportions between the amount of current and the diameter of the carbon the increase of light is in the direct ratio of increase of diameter, powerful lights requiring carbons of large diameter, while smaller lights require those of less diameter.

The Jablochkoff Candle.—Among the earlier methods of producing the electric light was the candle invented by Jablochkoff, a Russian military officer, in 1872, about five years subsequent to the invention of the Gramme dynamo; and its use had been continued up to a comparatively recent date, 2,500 of these candles being used in Paris for street lighting as late as 1880, and though finally superseded by better methods it will always possess a historical interest on account of its success and popularity in the early history of electric lighting.

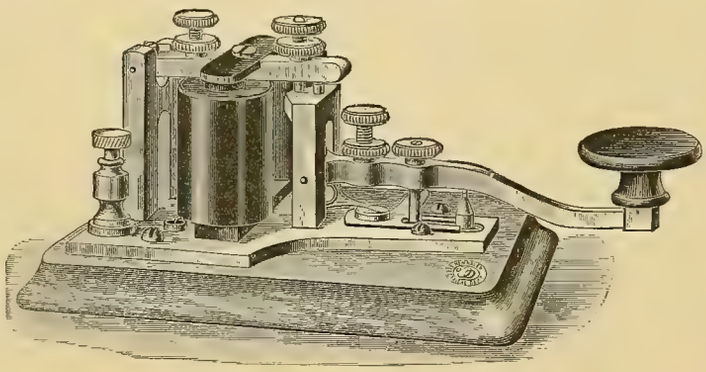
Its construction is exceedingly simple, consisting of two carbon rods, each about 8.33 inches in length, and $\frac{1}{8}$ inch diameter, mounted vertically, side by side, on a base, at about $\frac{1}{16}$ of an inch apart, and insulated from each other by a composite substance of which kaolin—porcelain clay—is the principal ingredient; which also forms an attachment between the carbons, and produces the effect of the lime light as it consumes in connection with them. The candle thus formed is supported on the base in a double spring clip through which the current enters, passing up one carbon and down the other, the upper extremities being connected by a strip of graphite or other carbonaceous substance, which acts as a primer through which the current passes to establish the arc, and is consumed in the process, the current being subsequently maintained through the arc in the usual manner; hence if, through accident, the light becomes extinguished it cannot renew itself.

As equal consumption of the carbons is an absolute necessity with this candle, it can be used only with the alternating current. Each candle lasts about an hour and a half, and lamps are constructed containing several candles, and furnished with apparatus by which the current can be changed from a burnt out candle to a new one; each having a separate connecting wire, while one common wire is used for the return current. Hence a lamp containing six candles furnishes light for nine hours.

The required horse-power on a circuit of five candles is 1.57 per candle, with ten candles 1.27, and with twenty candles .92; and the illumination of each light, without globe, 400 candle power. It is evident that since the crater of the positive carbon as well as the point of the negative faces upwards, there must be, with this system, a great waste of light from direct upward radiation. The incessant variations of tint and brilliancy in the light, and the noise produced by the alternating current has of late aided to bring this system, once so popular, into disrepute.

Private Line Telegraph Instrument.

In connection we give an illustration of a new private line telegraph instrument designed by the New Haven Clock company, in which compactness and simplicity are self-evident features. The key lever is hinged upon the front posts of the sounder instead of having separate trunnions. A new feature in the key is the post, passing through the lever with a check nut on top, for adjusting the tension of the key. This post is so arranged that the lever can be worked without any friction on it, but it keeps the contact points always in the proper position.



The switch is different from any heretofore used and is even more simple than the old lever switch. It makes a scraping contact which is always true and sure.

The complete instrument is mounted upon a polished wooden base, just the size of the common sounder base. The magnets are inclosed in hard rubber spools and all other parts of both key and sounder are made of brass with a finish equal to that of standard Morse sets; owing to the simplicity of the instrument and the special machinery possessed by the manufacturing company for working in brass it can be sold at the same price as instruments made largely of iron.

Chicago Telephone Girls.

The *Daily News* of Chicago, has been investigating the telephone service, concerning which the *Herald* and *Tribune* have been finding so much fault, and thus records impressions made by a visit to an exchange office:

"For the purpose of learning just how much fun those telephone girls were having at the other end of the wire, reading novels, chewing gum, and 'buzzing,' a reporter paid a visit to '2' office,

the largest exchange in the city. President Phillips, who assumed control last week of the city telephone system, was very anxious that a sharp eye be kept for novel readers and 'buzzers' in particular.

"Stepping into the exchange, the first impression is of the long switch-boards extending along either side of the room and a row of female forms industriously engaged before them. The hum and clicking of the pins and keys reminds one of a knitting-factory.

"None of the operators is more occupied than number 32, the amiable young lady who has charge of the *Daily News* wire. Her station is near the center of the right switch-board, and because of the extraordinarily large amount of business for telephone 1,457 she is required to answer but seventeen other 'phones. The usual number for any operator is twenty-eight. With a voice peculiar for its kindness and a disposition always to render good service, the *Daily News* operator never fails to give the best satisfaction. It is only fair for the others to say that Mr. Allison, the manager, was not slow to remark that they tried to please equally as well as number 32. 'Nearly all the complaints when examined,' said he, 'go to show that the subscriber was to blame, and not the operator. Last week, when a number of Chicago business men expressed themselves in interviews as being dissatisfied with their service, it came pretty hard on some of my best operators. I came up here the next morning and found several of them in tears. Strange to say, they were some whom I know to be the most obliging.'

"Each operator has a tablet on the shelf before her for the purpose of keeping tab on the calls for a certain 'phone when it is busy. On this she puts down the time, the number of the subscriber's 'phone, and the number of the 'phone asked for.

"'Busy! I'll call you,' is always her answer in such cases, and nine times out of ten she has a telephonic scrap with the one who rings her up before he will be convinced she is telling the truth and knows her business.

"It now becomes necessary to introduce the reader to the 'buzzer.' The 'buzzer' is the lady operator who neglects her regular business to gossip with some dude over the wire. The manager and the chief operators are constantly on the watch for 'buzzers,' but they are seldom found It is easy to fasten a clue upon the operator. Two minutes buzzing will permit the business to gather until the operator will fall behind. Once under suspicion the manager sits at a desk and with back to the operator suspected hears every word she utters.

"The manner of detecting a 'buzzer' is novel and very ingenious. On the manager's desk are three dials, each about the size of a buckwheat cake. Twenty-eight pieces of brass extend from the center of each dial to the circumference. Each strip of brass has a number. By pressing down on brass strip number 26 and pushing the receiver the chief operator can hear every word Miss 26 says. 'A new girl went to work one day,' said the manager, 'and she did so much 'buzzing' right in the start that I went up to her and said that was against the rules and must be stopped. I returned to my desk and saw her bend over to the young lady next to her. Pressing on the brass I heard her say: 'That duck is too darned flip, but he can't come it over me.' She was quite surprised when she heard me tell her through her 'phone to come up to the desk and get her time.

"Notwithstanding the many complaints about 'buzzers' they are as scarce as May apples. Moreover the reporter couldn't discover a solitary operator chewing gum, though he looked sharply; and, as for reading novels, it is preposterous. The operator hasn't time to sharpen a lead-pencil, let alone devote to a lazy perusal of some thrilling love story. She puts in nine and a half hours of good solid work every day, with but thirty minutes for lunch, and it must be a a very thoughtless person, to say the least, who says she neglects her business."

Some experiments have been recently made in St. Petersburg with the idea of slaughtering cattle by electricity, the results of which have been highly satisfactory—death being instantaneous.

One of the Causes of the Inefficiency of the Reis Telephone.[1]

By A. E. Dolbear.

Some who have experimented with the Reis telephone declare that they have never been able to hear a transmitted word. Others have heard some words and sentences; but these have always been weak and irregular, so as generally to discourage one in a short time, especially now, when through the improvements in telephones it is possible to reproduce words both loudly and regularly. Experimenters therefore have been impatient with Reis' apparatus, and seldom have done anything with it, except make some hasty tests for some phase of the great telephone controversy.

The inefficiency of the Reis telephone has, by a kind of common consent, been admitted to be altogether due to the imperfect mechanical operation of the transmitter, by which the making and breaking of the current when it is in operation is such as not to properly follow the actual vibratory movements of the diaphragm when the latter is moved by speech-vibrations; that at best it can deliver to the line only the fundamental rate of the vibration, leaving out the characteristic over-tones which are supposed to be necessary to the successful transmission of speech. This judgment as to the mode of operation of the transmitter has been derived wholly from what has been heard by one listening at the receiver; for there is to-day no known method by which it may be determined whether or not a transmitter has the proper motions, except by listening at the receiver. That is the test. Hence it has been concluded, that, if speech was not properly delivered in a receiver, the trouble must be with the lack of proper movements of the transmitter. Yet it is mechanically possible for the transmitter to move properly, and the receiver to be so much overloaded, so to speak, that the latter fails to be heard on account of the extra disturbance.

The page effect—the magnetic click—may be so strong in a Reis receiver, with a proper current, as to be heard a good many feet distant from it. When the receiver is held against the ear, the sound may be very loud; so much so as to quite drown weaker sounds, if they happen to be present. Especially when these loud sounds occur fifty or one hundred or more times per second, the effect is that of continuous sound; and as the persistence of hearing is something like the tenth of a second, it follows, *a priori*, that such rates of vibration as from two hundred to a thousand per second might be present, yet too weak to be heard in the presence of such overpowering sounds that have an appreciable persistent effect. These loud magnetic clicks are heard only when there is a sudden break in the current in the receiver. If, then, some way can be devised for preventing these extraneous sounds in the receiver without interfering at all with the transmitter or its "mode of operation," one may experimentally determine whether the Reis transmitter does or does not act mechanically so as to vary the current in correspondence with speech or other sound-vibrations. I therefore conceive, that, if there was a short-shunt circuit between the terminals of the transmitter, some of the currents would traverse the coil of the receiver the whole time, no matter whether the circuit through the transmitter was open or closed. The loud clicks would be suppressed without interfering in any way with the "mode of operation" of the transmitter; and, if the latter really did follow the motions of the diaphragm, the variations in the current strength would correspond, and the speech would be heard. This I found to be truly the case; for with a transmitter thus provided with a shunt circuit of about two ohms, which could be switched in or out with a key, it was at once possible to hear a large part of what was spoken when the shunt was in; when it was out of circuit, the sounds were generally inarticulate.

This experiment is an *experimentum crucis*, and proves that the inefficiency of the Reis telephone is much more due to the extraneous sounds in the receiver than to the lack of appropriate motions of the platinum terminals of the transmitter. It proves that the transmitter does and must always have worked in the proper mechanical way, and that the current theory of its mode of operation is not correct. It proves, too that when carbon is substituted for the platinum terminals, there is an improvement in efficiency, but not in its mode of operation.

[1] *Science*, January 20th.

A Government Telegraph.

On the 20th inst. the United States Senate post-office committee heard arguments in opposition and in favor of government telegraph bills.

Dr. Norvin Green, president of the Western Union Telegraph company addressed the committee at length. He devoted himself first, though briefly, to the constitutional questions to which the measure gives rise. He quoted a decision of the supreme court in effect that the telegraph is necessary to commerce, and that the telegraph business is in itself commerce. Was the government, he asked, empowered by the constitution to enter into inter-state commerce?

Dr. Green showed that the English rate of 12 cents for twelve words, including date, address, and signature, would in a large number of cases, if applied to messages sent in the United States, amount to more than the current 25 cent rate charged by his company. The address and signature in English messages were very much shorter as a rule. The British system had 29,800 miles of line, carrying 173,000 miles of wire and cable, covering an entire area in the United Kingdom of 121,000 square miles, and the most distant offices were separated by less than 600 miles. It had 6,541 public telegraph offices. The salaries of operators and other employes averaged about one-half those paid in this country. This system does a business of 50,243,639 messages per annum. To handle a business of about 3,000,000 more messages in a year, telegraph lines in the United States have 176,000 miles of line, carrying 630,000 miles of wire and cable, maintaining 17,000 offices, and covering an area twenty-five times as great as that of the British system. As to long distance rates, there was no part of the world in which messages were handled so cheaply as here. The maximum rate of $1 for the maximum distance of from 4,500 to 4,800 miles was cheaper than any other long distance rate, except from France to Algiers, which is over a French government line.

It was insisted, he said, that the Western Union Telegraph company is a monopoly. What, he asked, was a monopoly? The Western Union had no exclusive franchises or legislative grants. The elementary patents of the telegraph had expired, and the field was open to anybody who might choose to enter it. The Western Union was no more a monopoly than any great commercial business. It had come to be a maxim in commerce that the aggregation of capital in large enterprises cheapens production, and therefore tends to public welfare. The history of government telegraphs was noted only for tardy and blundering service, and especially were government systems indifferent to prompt deliveries. They deliver at their leisure.

The doctrine of the Western Union was that its greatest competitor was time, and just as far as it could overcome time could it increase its revenues. It was this which had compelled it to build 34,000 miles of line last year, not including the purchase of the Baltimore and Ohio.

Would the government observe any greater degree of secrecy than a private corporation, especially as to messages involving the heads of the government who were immediate employers of the subordinates who handle the messages? No government administration would, of course, demand the betrayal of the secrets of the telegraph, but he presumed a government administration would fail to punish such betrayal adequately if it resulted in great service to itself.

The government certainly could do a cheaper service if it chose to foot the expenses. In the compact system of Great Britain, covering less than one twenty-fifth of the area of the American telegraph lines, there was a deficit of $2,349,000 in the last fiscal year. Should the government undertake the work in this country, the number of offices would be increased and the deficit would be very much greater. If an American telegraph system were established, with rates similar to those of the English, there could hardly fail to be a deficit of less than from $5,000,000 to

$10,000,000 annually. But if the government must take the telegraph he insisted that it should take the existing property. Whatever the government does it should do exclusively. No private enterprise could run in competition against the United States treasury. In conclusion, Mr. Green said that there were some popular clamors that had been proclaimed until people believed them which he wished to take occasion to refute. First, as to the value of telegraph properties, and especially of the Western Union. The sum which had been stated as that which would serve to duplicate the Western Union property would be totally inadequate to purchase even its 600,000 miles of wire in factories, while poles, appurtenances, fixtures, instruments, etc., had cost three or four times as much.

The next popular error which he wished to speak of was the assumption that the Western Union was owned by one man personally. Never in its history had this been the case. The entire board of thirty directors owned not more than three-eighths of the stock, while the rest was owned by more than twenty thousand people.

Gardiner G. Hubbard then addressed the committee in favor of the postal telegraph system proposed in the bill introduced by Senator Dawes. He gave it as his opinion that of the $86,000,000 of capital stock of the Western Union company about $8,000,000 or $10,000,000 had been paid in cash by the stockholders, and probably as much more by stockholders of other telegraph companies which had become bankrupt and had then been bought up by the Western Union, and that the rest of it had been taken from the public in the shape of telegraph tolls. It was true as Dr. Green had said, that the present value of the Western Union property was very large. He did not believe it would be possible to duplicate its 600,000 miles of wire for less than $100 a mile, which would amount to $60,000,000. Over and above this value of the property were other large values. He had always regarded its right of way over the railroads of the country as being nearly as valuable as the other franchises of the company. There was then this great monopoly, with a capital of $86,000,000 nearly three-eighths of which was held by the directors of the company. The directors, therefore, had virtually a monopoly and controlled the whole business, since it would be utterly impossible at any stockholders' meeting to obtain a controlling vote over the stock held by the directors themselves.

Dr. Green corrected the statement, and said that frequently at stockholders' meetings three-fourths of the stock was represented.

Mr. Hubbard said that in his country there was, practically speaking, no competition in the telegraph business, and there could be none, for it was a business which could be managed much more easily and cheaper by one company than by a number. But the question arose whether the government could not manage it much more cheaply than the Western Union company, and whether that company could not manage it much more cheaply than it does. Mr. Hubbard thought the question should be answered in the affirmative.

NATIONAL BOARD OF TRADE.

The National Board of Trade considered among other matters that of "Postal telegraphy" at their meeting in New York on the 20th.

F. B. Thurber, of New York, spoke in favor of the post office department assuming charge of telegraphic communication. He read a letter from Kenric B. Murray, secretary of the London chamber of commerce, replying to certain questions previously submitted by Mr. Thurber. Mr Murray wrote that the result of the purchase and operation of the telegraphs by the British government had been successful as far as service is concerned, but not financially to the post-office, and that public opinion is now in favor of taking over and working the cables to Europe, the monopoly of which is now expiring. The general belief is that the quickness, certainty, and secrecy of the service have improved under the postoffice.

Secretary Murray in his reply then took up questions *seriatim* as follows: Q. Has the increase in the number of employes in the post-office department been productive of political evils? A. None worthy of being noted. Slight complaints have occasionally arisen in regard to promotion, but considering the magnitude of the service, numbering 54,800 persons regularly employed and about 47,000 persons irregularly employed, it is exceptionally free from "political evils." There have been one or two agitations for increase of salaries, one of which was successful.

Q. Have improvements and inventions in telegraphic communication, in consequence of the telegraphs being owned by the government, ceased or diminished? A. Not altogether ceased, as the postoffice department have in their employ eminent electricians and engineers who introduce improvements annually, or adopt outside inventions when thought desirable. The inducement is probably not so great "to invent" as when the telegraphs were in private hands.

Q. Has the recent reduction in the price of telegrams to 6 pence for twelve words been of benefit to the public, and how much has it decreased the revenue of the telegraphs and the number of telegrams? A. It has undoubtedly been of great benefit to the public, although the utility of the change has been somewhat detracted from by the fact of the address being counted in the words sent. The number of messages exclusive of railway, press, official, and foreign telegrams, which are not affected by the reduced rate and number some 10,000,000, dispatched in 1886-'87 was 40,137,175, compared with 30,087,869 in 1885-6. The revenue in 1886-7 was £1,354,879, against £1,277,606 in 1885-6. The number of messages thus shows an increase of 33 per cent., while the revenue only increased by 6 per cent. This was the first complete year under the reduced rate.

Q. Would the public be willing to have the telegraphs go back into the hands of private companies? A. The overwhelming, in fact, almost unanimous, feeling would be in opposition to the return to private management.

Mr. Thurber added that the friends of the postal telegraph in this country contend that the transmission of intelligence is a government function; that electricity is the most important means of doing so; that the British service has been extended to a large number of places which would not have enjoyed its benefits if the telegraphs had remained in private hands; that the service has been greatly improved, is more efficient than in this country, and a great deal cheaper; that when the telegraphs were taken hold of by the government the uniform charge of a shilling for twenty words to any distance resulted in an enormous increase in the use of the telegraph; that large additions to the plant have been made and paid for out of the current receipts, and if the telegraphs have not each year paid the interest on the bonds issued for their purchase, if they had been credited with these betterments, and with the free service to the government departments, they would have been able to show a credit sufficient to pay the interest on the bonds, and if they were credited with the increased service given the public beyond what the private companies were giving at the time the telegraphs were taken over, it would now show an enormous balance on the credit side; that private companies would never have tried the experiment of a reduction in rates first to one shilling for twenty words, and subsequently to six pence for twelve words.

Erastus Wiman of New York spoke in opposition to government control. He said that in the British post-office report of 1887 the table of receipts and expenses for the year 1880-1 to 1886-7, inclusive, shows a steadily increasing deficit, amounting during the last fiscal year to over $2,300,000. To meet this loss the whole population is taxed to afford a cheap telegraph service to the very small percentage of the people that ever use it. The telegraph is essentially the adjunct of commerce, and it is estimated that not more than 26 per cent of the populace ever use it; and in the United States not over 5 per cent of the revenues of the telegraphs is derived from family and social messages. About 8 per cent is derived from news service, and the remainder, about 87 per cent, is commercial and speculative, the greater part being the latter. A large portion of this speculative business is for "bucket-shops" and pool-rooms, where chances are sold on races thousands of miles away.

Is it fit and proper, he asked, that the whole people should be taxed to lighten the expenses of 2 per cent. of the population? Aside from the press service, the whole number of messages is about 40,000,000, an average of two-thirds of a message to each inhabitant. As to quality of the service, all persons of any experience in European countries unite in recording the service on government telegraphs as generally bad, with no accountability or redress for even the most flagrant negligence. It is more especially tardy and uncertain in delivery when the message passes over two or more systems of government telegraphs, and the rate of tolls for messages passing from one country to another is always greater than for like distances in this country.

Of the 17,000 telegraph offices in the United States, more than three fourths are operated by railroad companies, which are obliged to maintain the stations for railroad service; otherwise they could not be maintained except at a loss. Are these all to come into government employ? If the British telegraphic system made a deficit of $2,300,000 a year, a government telegraph in the United States with four times its length of lines and three and a half the length of wires to maintain, covering an area of country twenty times as great, and with larger salaries, handling only about the same number of messages, and adopting the British rate of tariff, would probably make a deficiency of $10,000,000 per annum.

If the rightful demands of tax payers should require the lines to be branched and extended, and telegraph stations opened at every postoffice, the outlay for the plant would run up to nearly $200,000,000 and the deficit upon its operations be still greater. The aggregate appointees would soon exceed 100,000, or duplicate in number the present appointees under the administration of the general government, all of whom would presumably feel bound to work in the interest of their immediate employers. It would be the longest stride ever made by one act towards centralization of power, and a significent step in the direction of socialism and the theory of parental government.

After further discussion the following resolution was adopted: "Resolved, That the usefulness of the post-office department should be extended in the direction of telegraphic communication, and we urge upon congress the earliest favorable consideration of this question."

CORRESPONDENCE

New York Notes.

NEW YORK, Jan. 21.—Sudden death through accident, carelessness or ignorance, is unfortunately a concomitant of the modern systems of lighting by gas and electricity. The latest case to be recorded is that of two rustics from Shubenacadie, N. S., named Parker and Fulton, who came to New York on business and stopped at the International hotel, Park Row. They engaged a room with two beds in it, and day before yesterday both men were found dead on the floor. They had blown out the gas.

The three commissioners appointed by the legislature to consider the best methods of carrying out the death sentence have reported that the most merciful way of putting criminals to death is by electricity. The question is raised however, whether in the interests of society it is desirable that the horrors of an execution should be reduced to a minimim. Is the awful work of killing men for the sake of justice to be performed in the most merciful way, or in a way to excite terror among evil doers? The whole report is construed in some quarters as an argument against capital punishment. One thing is certain and deserves consideration, that in the use of a powerful electric current for dispatching criminals there would be no chance of such bungling operations as are continually disgracing the use of the gallows.

George Addy, residing at Paterson, N. J., some time ago took the liberty of cutting down the poles and wires in front of his house Two indictments were found against him by the grand jury and his trial resulted yesterday in a verdict of not guilty. His defense was that the poles were put up in front of his house without his permission and while he was sick, and that as he paid for the flagging, curb and gutter, he controlled the street in front of his premises as far

as the middle of the road, and the jury sustained him in this position.

Your correspondent is pleased to note a recent visit to the office and shop of Shaw & Geary, of Philadelphia. These gentlemen manufacture specialties for the electrical trade. With skillful workmen and machinery of the latest and most approved patterns they turn out apparatus that is giving the best of satisfaction. They pride themselves particularly on their bells and buzzers, in which they use only the best Norway iron, and their door and window springs, which are simple in style and perfect in operation.

The next meeting of the American Institute of Electrical Engineers will be held February 14th, when Dr. Louis Duncan, of Johns Hopkins university, will read a paper on alternating current motors.

Members of the Electric club are earnestly requested to be present at the opening of the new club house on the evening of January 31st. An address will be delivered by Prof. H. A. Rowland, of Johns Hopkins university. Only members of the club, and invited guests, will be admitted on this occasion.

The C & C. Electric Motor company have forty of their one-eighth horse power self-regulating motors in operation in the clothing factory of A. Benjamin & Co. on Bleecker street, New York.

Chas. A. Schieren & Co., report sales of their leather link belting this week to the following electric light companies, for use with dynamos: Natick Electric Light company, Natick, Mass, Morristown Electric light company, Morristown, N. J., Nashua Electric Light company, Nashua, N. H., South Framingham Electric Light company, South Framingham, Mass., Edison Electric Illuminating company, New Orleans, La.

Harry Hall, formerly agent for the Edgerton Electric Motor company, at Boston, has accepted a position with the Sprague Electric Motor company and will be stationed at Rochester for the present.

A fatal accident occurred this noon in the electrical subway at the southeast corner of Sixth Avenue and Thirty-second street. Leonard Jones and Walter Harper, both employes of the Western Electric company and engaged in the cable department of that company, entered a man hole for the purpose of making some connections on cables laid for the Metropolitan Telephone and Telegraph company.

Before entering the man hole the men stretched a canvas screen across two barrels on the windward side of it, in order to keep out the wind and snow. The wind was blowing in strong gusts at the time, and in a few minutes the canvas screen was blown over the opening to the man hole. Passers by soon heard cries from within, and a stranger lifting the canvas saw both men lying helpless at the bottom of the hole. Help was quickly called and the men taken out. Harper, who lay on top of Jones being raised to the surface first and Jones a few moments later. The men were found to be asphyxiated by gas, and three doctors who were in the crowd that gathered worked to resuscitate them. Harper was soon out of danger and taken to a hospital, but Jones expired in a few minutes. Leonard Jones was 33 years of age and leaves a wife and family. He came from Boston only a few weeks ago to accept the position with the Western Electric company. A.

From St. Louis, Mo.

St. Louis, Mo. Jan. 21.—The failure of the Guernsey Furniture company, of this city, has created a ripple of excitement. The company was organized in 1882, succeeding Guernsey, Jones & Co. D. W. Guernsey then held $20,000 stock, Cyrus Jones $20,000 and George W. Parker $25,000 of the total capitalization, $65,000. Later the Jones and Parker holdings were absorbed by D. W. Guernsey and C. R. Scudder, who, with an employe holding a share or two, constitute the company at present. They seem to have done a fair business in fine furniture, and were generally regarded as prosperous. The assets of the company are placed at $66,000 and the liabilities at $60,000. Some time ago, as the result of a quarrel among the stockholders of the Excelsior Electric Light company, the Guernsey Furniture company purchased the plant of the Excelsior company, and have since been furnishing lights to consumers. But the assignee, William H. Scudder, jr., announces that the electric light plant will not be discontinued, but will be operated as heretofore. Mr. Guernsey is the agent in St. Louis of the Sprague electric motor, and has given much time to the motor and light business.

The Brush motor armature has arrived from Cleveland and is now in possession of the Lindell Railway company. Another trial of the motor will be made, it is expected, this week. Nothing has been heard from the Sprague motor, which was to have been here six months ago. C.

From Kansas City.

Kansas City, Mo., Jan. 21.—The depredations committed by foot-pads and burglars in this city have aroused the police commissioners to take measures that will either increase the police force numerically or strengthen it by the adoption of a police signal system. This morning's *Journal* contains an extended interview held by one of its reporters with W. O. Huckett, secretary of the board of police commissioners, illustrated by cuts. After describing a police signal system and its method of operation, Secretary Huckett continues :

"All the police signal apparatus I have seen or of which I have read, contain what to my mind is a very serious objection. The policemen on the beats can communicate with the central station at will, but no matter how urgent the necessity, the officer in charge of a station is unable to call up and converse with his subordinates. As a business proposition, does that seem proper. As I am not an electrician, I can only theorize upon the subject, leaving to those skilled with electrical appliances to determine whether my ideas are feasible, and to plan out the details. I would discard the use of the clock-work in the street box and in its place have a large bell or gong, also a push button like those you find at the front door of a residence, operated by electricity. The officer on his rounds, desiring to notify headquarters,opens the box and presses the button. This releases the electrical current, and causes a figure, say 94, to display itself in a case annunciator at police headquarters, similar to that found in offices of well equipped hotels. No matter how many calls came in at the same moment, there would be no jumble, as might occur with the use of dashes on a tape. Each street box should contain a good gong. The operator at the central station on receiving a call would press a button, which would cause a tap on the gong in the street box, and be a notice that the policeman would be registered in the tally sheet as on duty. Should the operator desire to converse with the officer, two pressures of the push button, and consequently two taps of the gong, would indicate to the policeman that he must use the telephone in the box. If, on the other hand, the policeman had something to communicate, he would, on receiving the signal that his signal, 94, had dropped, push the button and cause it to drop again. If the policeman had locked his box and gone away, a continuous pressure of the push button at the central station would ring the gong in the box so loudly that he would hurry back to ascertain the cause of the alarm.

Under the systems now in use elsewhere, it would take from thirty to sixty minutes to apprise all the police on the various beats of an import ant event. I would agree that all of them could be notified in five minutes."

"How would you accomplish that?" questioned the reporter.

"On about the same principle that the guests of a hotel could be notified of a fire on any floor or a general alarm sounded all over the house. With such a police signal system in operation, should the central station receive a telephone communication that a black horse, top buggy, and red lap robe had just been stolen from in front of the *Journal* building, it would not be necessary to wait thirty or sixty minutes for the policeman to call up and inquire if there was anything new, but by means of a lever a general alarm would be turned on, causing the gongs in all the boxes, or in any certain district, if desired, to ring until each policeman hurried to shut it off and find what was wanted. The thief could not get five or ten miles away with the rig, but it seems to me the officers would get the information so quickly that he could be surrounded, as it were. If the officer should be at such a distance from the box that he could not hear the bell, persons passing would soon notify him of the fact, and he would hurry to ascertain the cause."

"Is there anything further you can add to the subject?"

"Only that I would be proud to see 100 boxes located about the city, and ten keys to each box distributed to stores and residences in the immediate vicinity. What an auxiliary the 1,000 persons would be in giving notice of a fire or serious disturbance. By means of our excellent telephone system we can, in case of emergency, use the instruments in stores and residences, but at a late hour of the night the police can not so intrude, and the men are almost destitute of means to call for the patrol wagon. As the *Journal* has suggested a police signal service is greatly needed, and in giving you my ideas it is with the hope that men who are practical in such matters will turn their attention to supply the want in this direction, not only in Kansas City, but elsewhere. It is a good field in which to operate."

"Why would not a telephone in street boxes, without any other apparatus answer the purpose?"

"I expect it would, if there was a central office or exchange, constructed at police headquarters, so as to show what number of box the call came from. Policemen on beats are required to move from place to place. The different numbers on the box show they are performing that duty; otherwise, you know, a man could stay in one locality, and, at his stated intervals, use the same box and report that he was in another part of the city—see?"

"Then you invite the views of police officials and electricians as to the feasibility of your ideas?"

"I do, and would be pleased to hear from them." C.

Indianapolis Items.

Indianapolis, Jan. 21.—The Delphi, Ind., Electric Lighting company have filed the necessary papers with secretary of state.

The Jenney Electric company, of this city, has quite a force of men wiring the new union passenger station, for incandescent lighting. The same company will also furnish the arc lights for the train sheds.

The cold snap last week left Madison, Ind., in the dark one night, owing to freezing the fixtures on streets, so that the electric lamps conld not be lowered or reached for trimming.

The citizens of Rockville, Ind., are agitating the question of electric lighting. The firm of Dooley & Connelly are in correspondence with electrical manufacturers as to probable cost etc. The Edison system seems to be the favorite so far. M.

From Cincinnati, O.

Cincinnati, O., January 21.—Two bad fires occurred here this evening. Jones Bros. manufacturers electrical instruments, Longworth street, burned out; loss, $10,000. Seabastian, May & Co., Pearl street, sustained a loss of $25,000.

THE ELECTRIC LIGHT.

Burlington, Ia., is putting in a United States alternating plant.

Cedar Rapids, Ia., will shortly have a Westinghouse alternating plant in operation.

The Citizens' Electric Light & Steam Heating company of Peoria, Ill., has been incorporated with a capital stock of $25,000; incorporators, Edwin M. Ames, Gustav A. Schaeffer, W. H. Day, Kirby C. Pardee, Samuel Gorton, T. B. Cooke, and others.

Port Huron, Mich., will operate its own electric light plant, putting $14,000 in as a starter.

Pawnee City, Neb., celebrated the death of the old and the birth of the new year with a blaze of electric lights. The plant cost $10,000.

F. A. Brooks will be the electrician of the plant at El Dorado, Kan.

Johnson, Holland & Co., of Chicago, have taken a contract to equip two trains on the Chicago, Burlington and Quincy road, to run between Burlington, Iowa and Albert Lea, Minn., with accumulators for electric lighting.

Grand Rapids was much exercised over a strange light in the sky Jan. 2nd, and referred the matter to Professor Lewis Swift, the celebrated Rochester astronomer. He has looked it up, and advises Grand Rapids to keep cool, as the electric light always acts that way In slightly foggy weather.

At the annual meeting of the Badger Electric company, limited, Racine, Wis., George P. Nichols was elected treasurer and manager and C. M. Fay was appointed chief engineer and electrician. The plant of this company, one of the finest in the state, consists of five Thomson-Houston arc dynamos, two incandescent dynamos of the same make, each of 500 16 candle power light capacity and one alternating current dynamo. The steam plant consists of one 18x42 Reynolds-Corliss engine and two 50 horse power Payne automatic high speed engines and a battery of four boilers.

The Western Electric arc light plant at Independence, Mo., was started January 21ts.

The recently elected officers of the Kansas City Electric Light company are as follows: President, W. B. Grimes; vice president, F. K. Hoover; treasurer, J. S. Chick; secretary, J. R. Barnhart; general manager, E. R. Weeks.

A franchise for an electric light plant granted by the council of Garden City, Kan., was conditioned upon work being begun within sixty days from November 19th. A local paper intimates that another franchise will be granted some other company as the original grantees have not fulfilled the condition imposed as to time.

Formerly steamers using the Suez canal were not allowed to proceed through it at night, but the use of the electric search-light has changed that regulation, reducing the average time of passing through from thirty-six hours to from fifteen to eighteen. For this purpose the Brush company devised a special cage, which is lowered in front of the bow of the vessel to within a few feet of the water. In it is mounted a powerful arc light, the rays of which are thrown far in front and to the sides by properly disposed mirrors and a dispersion lens. An attendant sits behind the lamp to regulate it. Vessels not fitted with the appliances take them on deck when entering the canal, and one set is thus made to serve many vessels.

The Stockton, Cal., Gas Light company has decided to adopt the Jenney system of electric lighting, in pursuance of its former resolution to embark in the business of a combined gas and electric supply. The order given calls for everything necessary to equip and maintain a 120-arc light plant. The arrangement wlth the authorities for public lighting calls for the erection of eleven 100-ft. towers.

The town of Orangeville, Canada, will receive sealed tenders up to February 1st, for lighting the streets. The town will take 15 lights, and it is probable that private parties will take 30 more. The lowest or any tender not necessarily accepted. Communications should be addressed to A. A. Hughson, town clerk.

THE ELECTRIC MOTOR.

At a meeting of the Citizens association of the north-west side of Chicago last Saturday evening to take action regarding the proposed extension of the street railroad system to that section of the city, resolutions favoring a cable system were adopted, but a proviso was made that if the electric motor could be used the association preferred it.

The VanDepoele electric road at Ansonia, Conn., it is expected, will be started soon.

The VanDepoele road from Brooklyn to Jamaica so far as the electrical equipment is concerned is working very satisfactorily. The track is low, however, and rains wash the sand on to the rails, making it impossible to run except after cleaning the track. The rails will be raised in the spring.

THE TELEPHONE.

A press dispatch from the City of Mexico, dated January 19th reads: An important decision was rendered yesterday by the first district court of the republic affirming the validity of the Bell telephone and Blake transmitter patents under the laws of Mexico. The defendants in the case, a German mercantile house, are ordered to deliver their stock of instruments to the Mexican Telephone company, to make a statement of their profits and hand them over, and to pay all the costs. The defendants will appeal to the Supreme court. The Mexican Telephone company have made a hard fight, and the case has excited much interest.

A reader of the Chicago *Herald* asked: "What is the longest distance that a person can be heard speaking through the telephone? Was there ever any direct communication between Chicago and New York by means of the 'phone?" The *Herald* replied: "There was once a temporary communication between Chicago and New York, but the speech was hardly audible. For distances of more than fifty miles the telephone has not been found satisfactory." New York and Philadelphia and New York and Boston are now in daily communication over long distance telephone lines, the line between the latter two cities, following the highways, being being at least 350 miles in length and the telephones work most satisfactorily.

The Cushman Telephone company went before the committee on fire and water of the Chicago city council on the 23rd, and asked for the passage of an ordinance allowing it to establish a telephone exchange and to lay wires in all parts of the city. The Cushman company proposes to serve subscribers in Chicago and all suburbs. It will agree in the ordinance to charge not to exceed $80 per telephone to subscribers and in private residences not to exceed $75 per annum. The committee referred the matter to the law department, with instructions to draft an appropriate ordinance, which will then be given careful consideration.

THE TELEGRAPH.

The Western Union Telegraph company has removed its poles and wires from the main street of Valparaiso, Ind., in compliance with an ordinance to that effect.

Conversation was carried on to-day by telegraph between correspondent Norman, in this city, and editor Stead, of the *Pall Mall Gazette*, in London, a distance of 6,900 miles over the Canadian Pacific, Postal and Mackay-Bennett cable lines, runs a press dispatch of the 22nd inst. from Vancouver, B. C. The time of sending messages and receiving answers was less than four minutes.

At a meeting of the Direct United States Cable company at London on the 20th inst. John Pender, the chairman, said the progressive development of the cable traffic could not be sustained by the 6-penny rate, which has ceased to give increased returns. He therefore advocated a conference to determine what would be a fair rate both for the shareholders and the public. If the traffic developed by the 6-penny rate could be maintained at a shilling rate, the increase would not burden the public and it would satisfy the company.

At a meeting of the board of supervisors at Vicksburg, Miss. January 16th, the assessment of the Western Union Telegraph company was placed at $25,000, and the assessment of the Great Southern Telegraph and Telephone company was reduced from $15,000 to $5,000. Mr. Pearson, agent of the company, made oath that the whole outfit of telephone wires, poles, etc., in the city was worth only $2,500.

The first private stock broker's wire put in between here and New York was ordered by Bob Parks, says the Chicago *Herald* gossiper. That was in 1881, and Parks had a business then that paid him $100,000 net every twelve months. Now, although he is playing in very hard luck, it is not likely that the Western Union, notwithstanding it got from his enterprise several millions of dollars, feels at all under obligation to him. The first wire was run between Parks' and M. S. Nichol's offices and cost $30,000 a year. Before that the most enterprising of the brokers had simply loops to the main office of the Western Union. They all had to follow Parks' example at once or lose their business. There were at one time fifteen or sixteen private wires between here and New York, paying in all about $450,000 a year for the service. The extravagance ran so high that a single firm, J. T. Lester & Co., had two wires of their own. As everybody knows, the speculative business has now become such poor picking that the brokers are going back to first principles, abandoning their private wires and putting in loops again as of old. Only five private wires are left, although the rental has been reduced from the $30,000 that Bob Parks paid to $15,000. The lessee of one of these was, the other day, bewailing the step that Bob took when he inaugurated lightning service between here and Wall street. "Speculators," said this broker, "would never have known the difference if we had all stuck to 'loops,' and we would have saved in the last seven years nearly $100,000 apiece.

Burglars entered the Leavenworth, Kan., office of the Pacific Mutual Telegraph company on the 18th but failed to secure anything of value.

The supreme court of Pennsylvania has affirmed the judgment of common pleas court number 2 in the suit of the city of Philadelphia against the Western Union and Mutual Union Telegraph companies to recover from these companies the annual license fee of $1 for each one of their poles erected upon the public streets and $2.50 for every mile of suspended wire.

Miscellaneous Notes

"Teleseme" is the name given a new instrument by its designer, F. B. Herzog, of New York. The instrument, from a published description, seems to be similar to the American district call box with the exception that the number of signals that can be sent over the circuit from it is not less than 150 while few American district boxes embrace more than ten or a dozen individual signals. The teleseme is particularly adapted for use in hotels where a guest in his room can make almost any want know to the clerk in the office by simply sending in the proper signal.

The scheme proposed by the Niagara Falls Hydraulic Motor & Power company of New York to utilize the power of Niagara Falls is as follows: Shore abutments of granite will be erected on each side of the Niagara river just above the falls. A steel cable ten inches in diameter will then be stretched across and fastened to the abutments. Connected with the cable are to be large flatboats made of steel and loaded with ballast; in the rear of the boats are large wheels connected by a universal coupling-shaft, so as to allow the current or ice to move the boats without interfering with the revolution of the wheels. This shaft is to be connected with an immense power house on the American side of the river in which will be located any number of powerful dynamos which will generate electricity that will be conducted to Buffalo and Rochester, N. Y., and other cities, by cables.

The Chicago Heat, Light & Power company has been incorporated with a capital stock of $5,000,000. The company will construct manufactories for the generation of gas and electricity for fuel, illumination and motive power, and contract for the supply of fuel, gaslight, and power for cities and manufactories, and manufacture machinery; incorporators, James P. Gardner, Robert D. McFacon, and Henry A. Gardner.

At Las Vegas Hot Springs, Cal., C. D. Warner, describing the exhilarating atmospheric conditions, in the January *Atlantic*, says,—"Everything and everybody was electrified, the hotel, lighted throughout by electricity, was a sort of big dynamo. We could not touch a bit of iron, turn on a light, brush against a portière, or shake hands without experiencing a tingling shock. Inside and out it was like being in a place enchanted."

A plant is under way in Brooklyn, N. Y., intended to refine sugar by using electricity. It is

claimed the new process will revolutionize sugar refining, reducing the cost of producing a ton of white sugar from the raw article to an expense of eighty cents, whereas it is now $7 to $10.

The experiment of fishing with electric lamps inclosed in glass globes, as a lure to the prey, has not as yet proved a success. A vessel thus equipped recently made a cruise to the Isle of Man. The lamps were sunk with the net to the depth of forty or fifty fathoms. The glass of the globes was three-eighths of an inch thick, but the pressure of the water was too great for the glass, which broke, and the lights went out. Experiments with stronger glass are to be made.

The estimate for the cost of the fire department for Chicago for the ensuing year is $1,127,628. Marshal Swenie says that "the increase over the estimate for the preceding year, about $250,000 is largely on account of the annexed territory, and then again the bridge telephone system and the maintenance of the police telephone operators have been added to our salary list. Annexation will cost over $112,000 and the other salaries added to the department will amount to nearly $50,000 more. A part of that increase will go to improving the service by adding to it. For instance, I propose to put over $130,000 into extending the telegraph alarm system, and in Hyde Park about $18,000 more is needed to extend the the fire alarm system there."

The latest in ærial navigation is the air-ship of Peter C. Campbell, of Brooklyn, N. Y. The most noticeable part of the machine is an egg-shaped balloon, whose longer and horizontal diameter is sixty inches, and its shorter or upright diameter thirty. It is made of light Japanese paper, oiled. It has a keel of silk whose lower edge is kept straight by a strip of wood, as seen in the picture. At each end of this strip there is a small propeller. The lower part consists of a boat-shaped arrangement made of silk, framed in light wood. There is an eight-bladed propeller at the stern, a horizontal propeller beneath, and a rudder of silk at the bow. A wicker basket in the middle contains a clock-work engine to work the propeller. There are silk wings on the side, shaped and attached somewhat like the wings of a bird, and capable of being set at almost any slant. It is intended to make the ship rise in the air, the balloon being relied on chiefly to keep the ship afloat. The stern propeller moves the ship forward or backward the same as the propeller of a steamboat. The two flat wings on either side of the basket, each seven inches wide, are used to guide the course also. Then at each end of the top ridge is another propeller, which will control the ship's movements. There is also a thin, small propeller forward of the basket and above it, for use in steering.

The new club house of the New York Electric club is now informally open and meals are served in the club restaurant. The formal opening of the house will take place January 31st.

At the meeting of the Polytechnic section of the American institute, New York, L. Duvinage said that the increased quantity and quality of work that goes out of the modern machine shop was due to the skillful use of solid emery wheels. He said that a grain of sand from the common grindstone magnified, would look like a cobble stone, a fracture of which shows an obtuse angle, whereas a grain of corundum or emery would look like a rhomboid, always breaking with a square or concave fracture. No matter how much it is worn down in use it does not lose its sharpness; hence it is evident that the grindstone rubs or grinds and heats the work brought in contact with it, while the corundum or emery wheel with its sharp angular grit cuts like a file or circular saw. There are two general classes of emery wheels in the market—one class of wheels has the grains of emery joined and consolidated by a pitchy material as rubber, linseed oil, shellac, or the like. These must run at a high speed to burn out the cementing material by friction, loosening the wornout grains and thus revealing new cutting angles. These are non-porous wheels. Truing up this class of wheels is done with a diamond tool. The other class consists of two kinds, one made by mixing the emery with a mineral cement and water into a paste, which will harden and bind the grains together; the other kind by mixing the emery with a mineral flux or clay, molding into shape and burning in a muffle at a high temperature. These are porous wheels in which the grains of emery are held together by matter having affinity therefor. This class of wheels, unlike the grindstone, has sharp grains of emery bedded together among matter which in some cases, is as hard and sharp as the emery itself. Such wheels cut very greedily and do not need to be run at any particular speed. The dresser, made of hardened steel picks, is the proper tool for truing up this class of wheels.

Personal Paragraphs.

George S. Bowen of Elgin, Ill., was a visitor at the Chicago Electric club rooms the latter part of last week.

Thomas Doolittle of New York, of the American Bell Telephone company was in the city a few days last week.

Francis W. Parker, of late an examiner in the United States patent office, has increased his facilities for conducting his business of patent soliciting and exploiting electrical inventions. His office is at 1003 Opera House block, Chicago.

The New York *Daily Graphic* of the 5th inst. gives a portrait, a biography and an account of some of the achievements of James F. McLaughlin, the inventor of the dynamograph, or Electrical type writer, mention of which has heretofore been made in these columns.

T. G. Gaylord, manager of the Louisville, Ky., Electric Light company, paid Chicago a brief visit last week.

N. O. Stevens, manager of the Thomson-Houston electric light plant at Quincy, Ill., and Miss Kate Norwood were united in marriage on the 18th inst.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	360	370
Central Union	43	44
Michigan	74	75
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	25	26
Missouri and Kansas	68	69

Business Mention.

The Brush Electric company of Cleveland, O., wrote the following self-explanatory letter to the Valley Iron works of Williamsport, Pa. "Your favor relating to engine which we recently purchased from you, is received. We have heard very excellent accounts of the working of your engine from our experts, who had charge of the installation of the plant — we understand that it is giving excellent satisfaction. We appreciate the quality of your engine, and if in the future we should be called upon to furnish engines of this description — will take pleasure in giving your engines consideration."

James J. O'Neil, foreman of construction of the Boston, Mass., police signal system, thus describes a test he recently made of the Campbell Electrical Supply company's line wire: "While putting up the Martin & Wilson fire alarm, we ran the wire from Pemberton square to the roof of Houghton & Dutton's store, and tied it up there for the night during a heavy rain. In pulling your wire on the fixture, we crossed the electric light wires drawing them together and causing a short circuit; the electric light wire gave a light equal to an arc lamp. We examined your wire and found the insulation perfect, not injured in the least. The same wire is there to-day all right, while the electric light wire was found to be burned out, and the insulation gone. I regard it as a fine opportunity to show the fire proof qualities of your insulation and its resistance to moisture, as your wire lay on the roof all night in the rain storm.

The D. M. Steward Manufacturing company of Chattanooga, Tenn., have re-organized under the laws of that state with a largely increased capital, and have erected permanent factory buildings of large capacity. A number of machines have been added, increasing the capacity of the works to more than quadruple that of the old works. The new works are nearer the base of supplies and thus in future delays on account of shortage of material will be avoided. This company is widely known for its make of insulators.

Holmes Booth & Haydens, who are never dilatory in meeting the requirements of their trade, have placed upon the market their well-known "K K" wire designed to take the place of underwriters wire. "K K" wire is an old wire put to a new purpose. It was first manufactured about eight years ago and the intervening time has so thoroughly proved its merits that its makers recommend it with confidence for its highly weatherproof qualities and its fitness for withstanding abration. Since placing this wire before the electric light trade, the entire line construction in three cities has been done with it not one foot of underwriters wire being used. The demand for this wire on alternating work is also large. J. L. Barclay, the western representative, has just returned to this city after a two weeks trip and reports large sales of "K K" wire. We understand it is also in the hands of all supply companies.

Electrical Patents.

Issued Jan. 17, 1888.

376,423. Car Lighting. Craig R. Arnold, Brooklyn, N. Y.

376,429. Tube-Motor Street-Railway. William G. Creighton, Norwood Park, Ill.

376,541. Mechanism for Electrically Controlling Stamping-Machines, etc. Ottmar Mergenthaler, Baltimore, Md.

376,562. Electric Conduit. Robert Van Buren and James J. Powers, Brooklyn, N. Y.

376,567. Electric Railway System. David G. Weems, Baltimore, Md.

376,569. Telegraphic Apparatus. Samuel B. Whitehead, San Francisco, Cal.

The invention is designed to prevent persons from stealing messages by means of eavesdropping. "In a muffled telegraphic message receiving and transmitting instrument, a box all the sides of which are made with an inner and outer casing, and the space between the casings filled with suitable non-conducting material, and having a cover or lid similarly constructed, and the edges of the box and of the lid or cover, where they come together to form a joint, being furnished with felt or other suitable material, the box also having holes through which the key and switch rods pass, suitably packed to prevent the egress of sound substantially as described."

376,579. Preventive of Incrustation of Steam Boilers. Charles J. T. Burcey, Syracuse, N. Y.

376,583. Combined Incandescent Electric Lamp Socket and Electrical Converter. Edward A. Colby, New Haven, Conn.

An annular core provided with coils is placed in the socket exterior to the lamp globe. Within this core is placed a second core also provided with a coil. The annular core is provided on opposite sides with two enlargements projecting inwardly beyond the coils, and the inner core is mounted so that its ends may be turned toward and from such projections. By adjusting the inner core a greater or less distance away from the projections the current induced in its coils, by the current traversing the coils upon the annular core, may be varied. Of the fourteen claims we give the tenth: The combination, with an incandescent electric light socket, of a converter within said socket and wholly exterior to the lamp globe, and consisting of an annular core having bare pole-pieces, supports or plates of non-magnetic material at the respective ends of said core, insulated wire wound upon said core, an adjustable core supported between said end plates, coils of wire wound upon the last-named core, and means for placing the last-named coils in circuit with an incandescent electric lamp filament.

376,615. Support for Telephone Receivers. William E. Thurber and John McConnell, Cleveland, Ohio.

376,617. Combined Gas and Electric Light Fixture Samuel B. H. Vance, New York, N. Y

376,630. Electro Magnetic Device. Charles E. Brush, Cleveland, Ohio.

The armature is so combined with a piston or weight that a current of momentary abnormal strength will not cause the device to respond. When applied to a multiple series cut out, in case the machine flashes, the temporary strong current produced immediately thereafter by the lamp carbons coming together will not operate the cut out.

376,651. Automatic Electric Valve. Charles J. Hexamer, Philadelphia, Pa.

376,661. Telegraph Repeater. Joseph Kolzer, Duisburg, Prussia, Germany.

376,706. Magneto Telephone. Fred. H. Brown, New York, N. Y.

376,707. Magneto Telephone. Fred. H. Brown, New York, N. Y.

376,709. Electro-Magnetic Brake. Nicholas J. Clute, Schenectady, N. Y.

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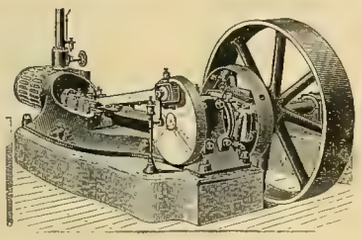

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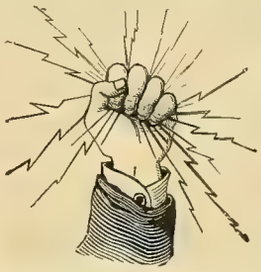

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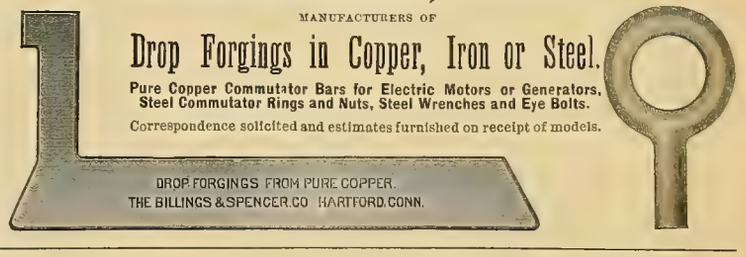

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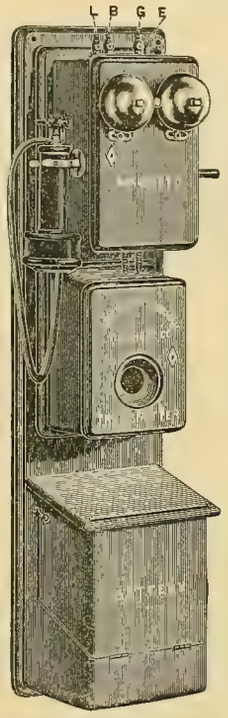

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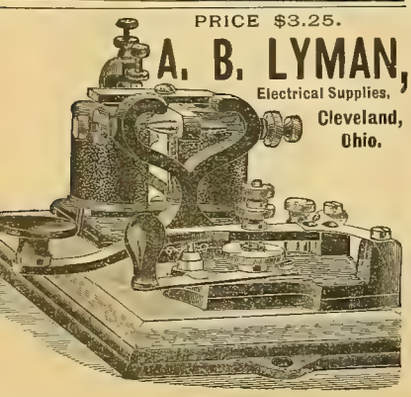

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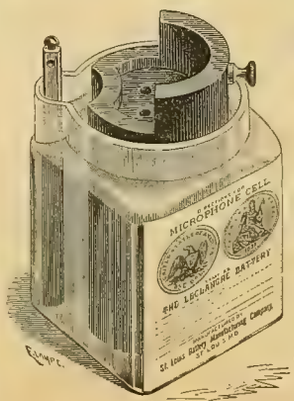

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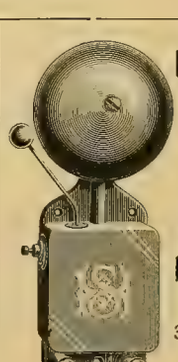

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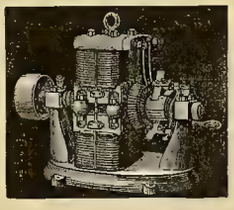

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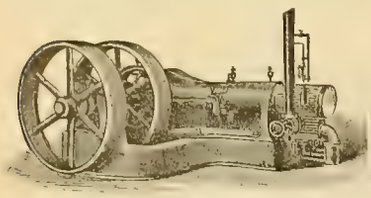

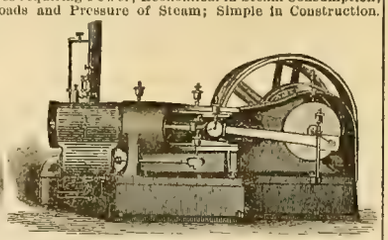

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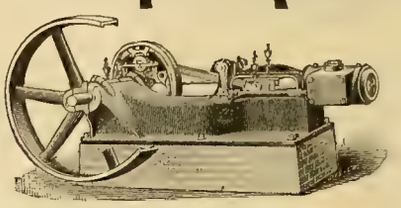

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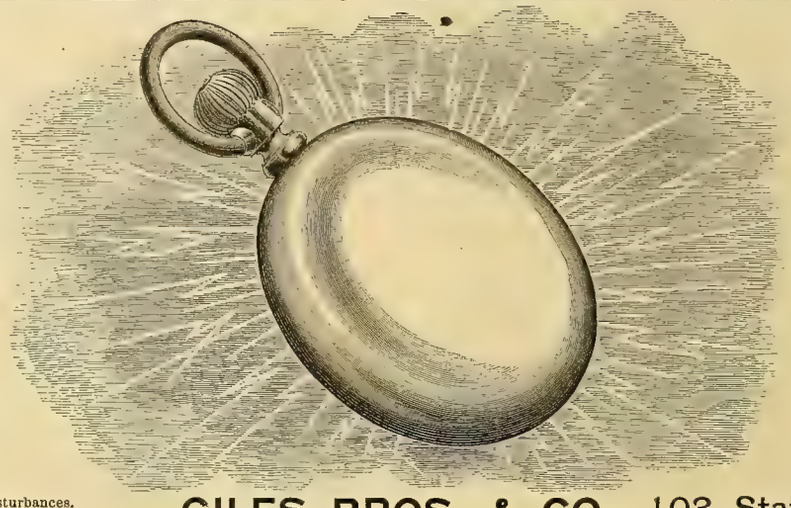

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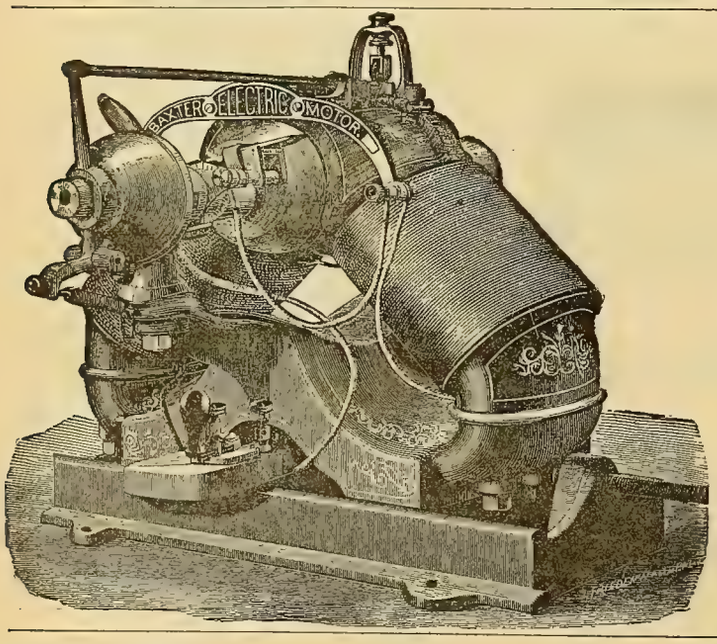

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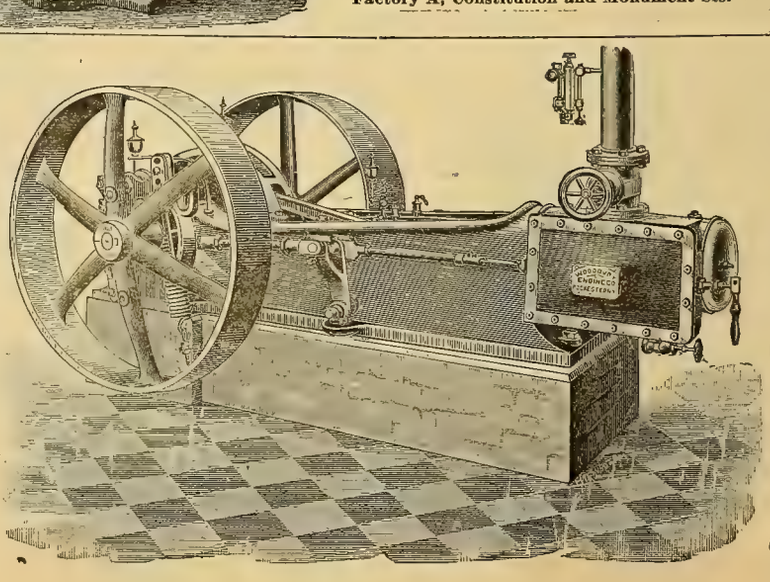

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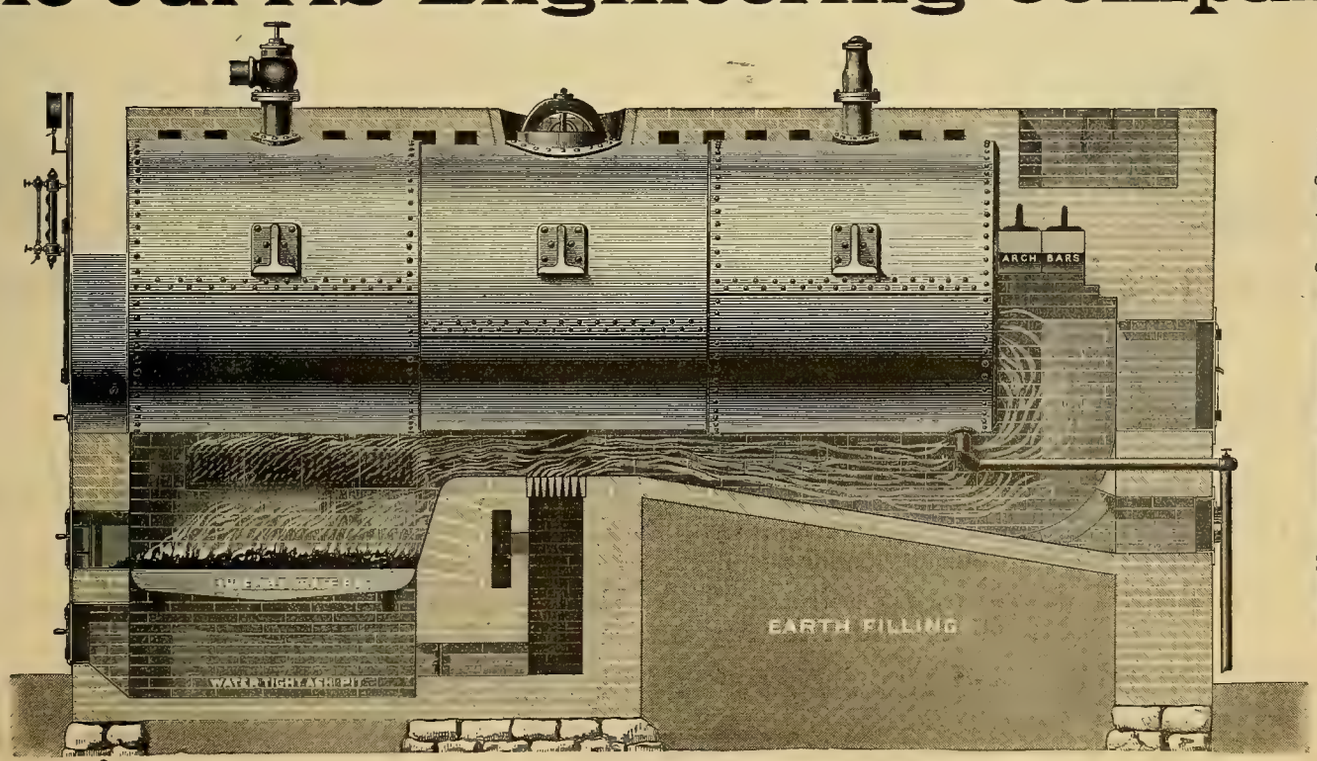

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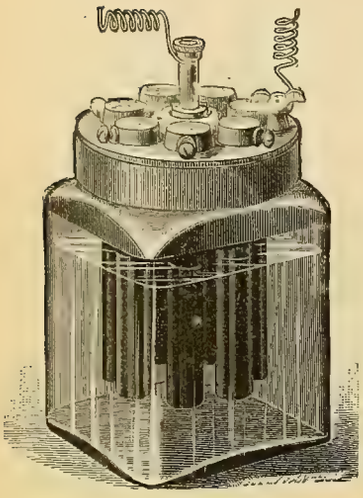

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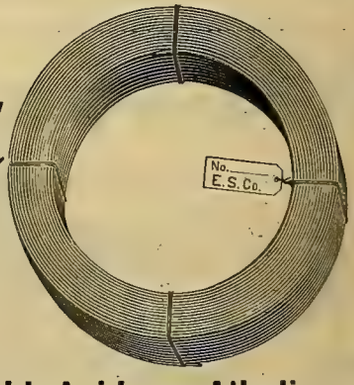

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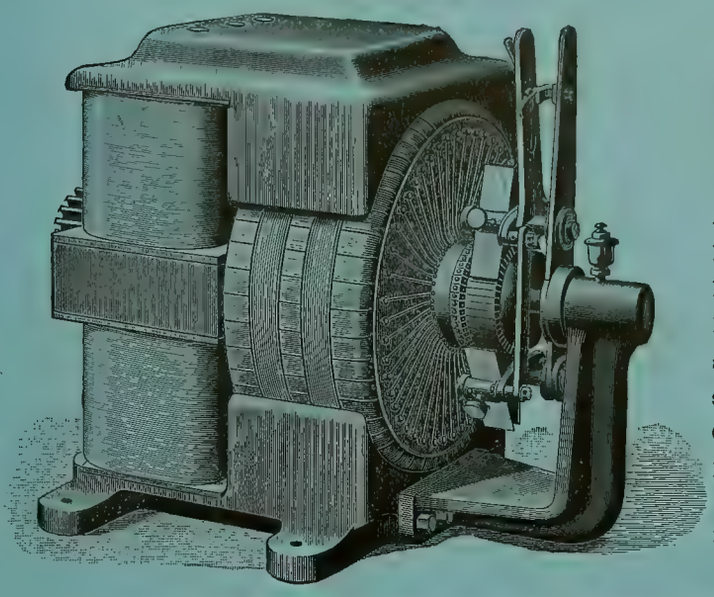

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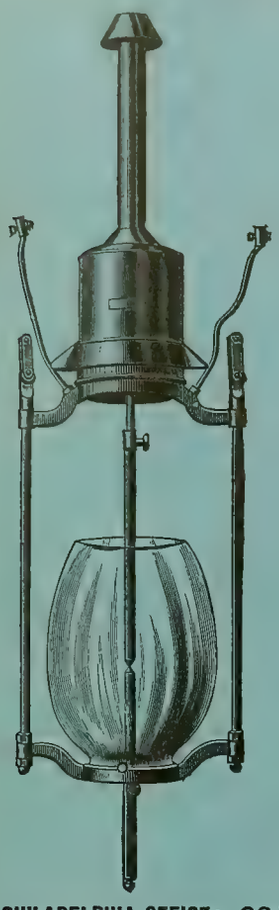

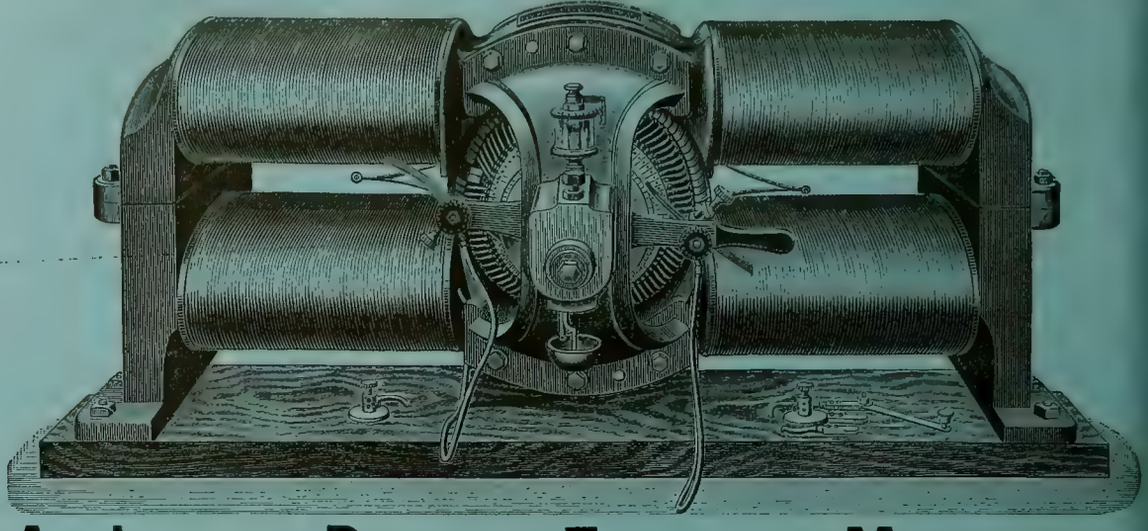

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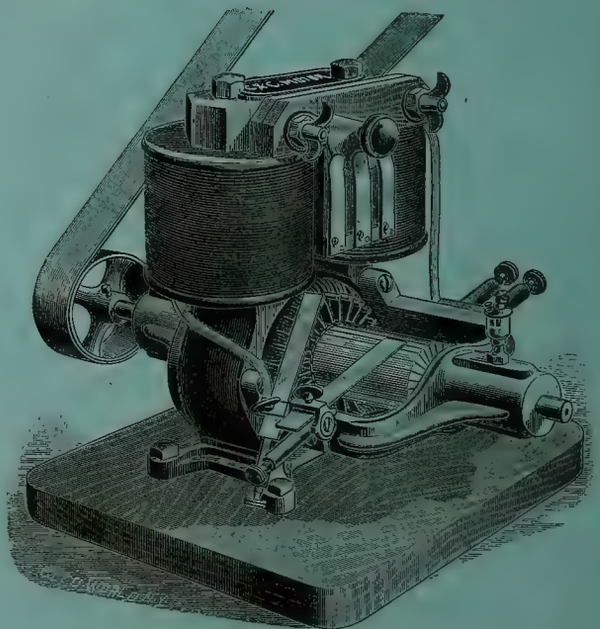

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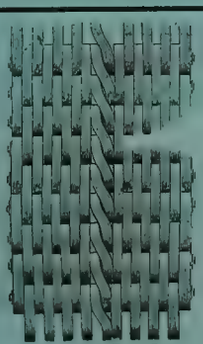

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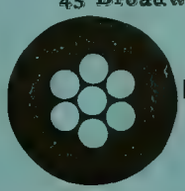

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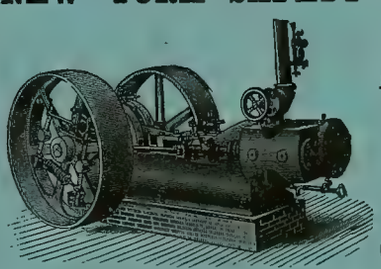

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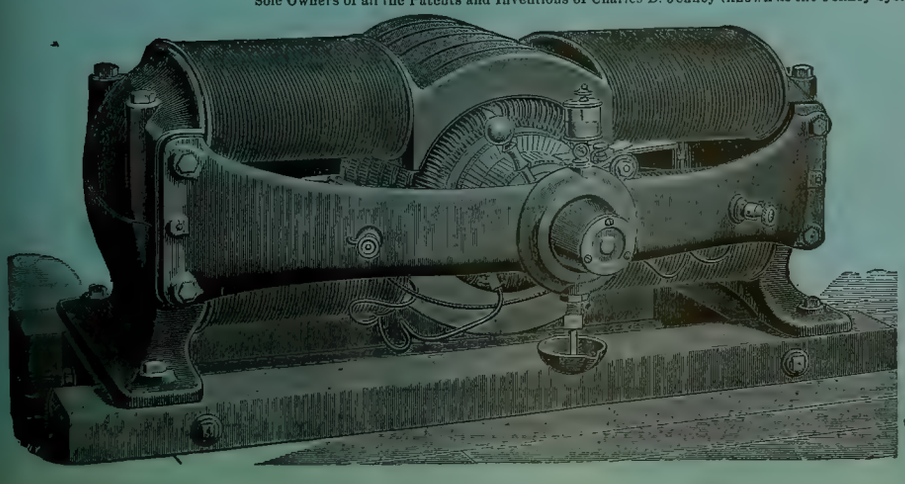

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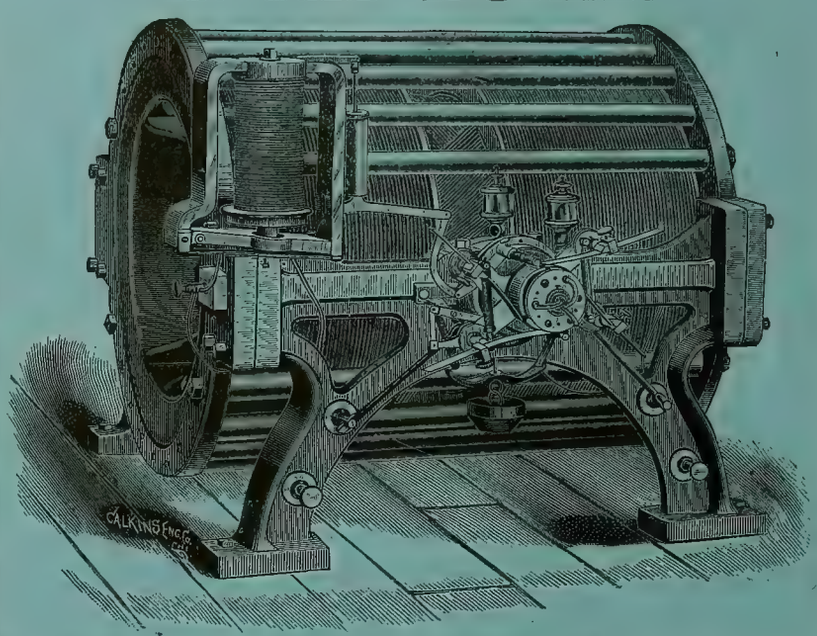

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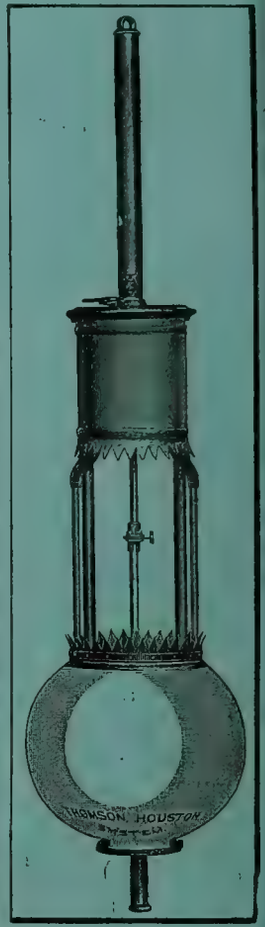

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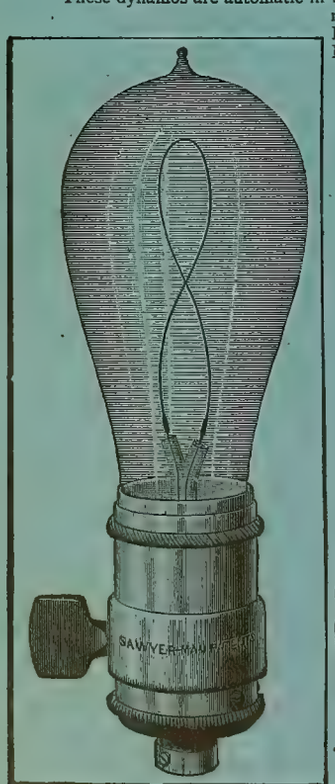
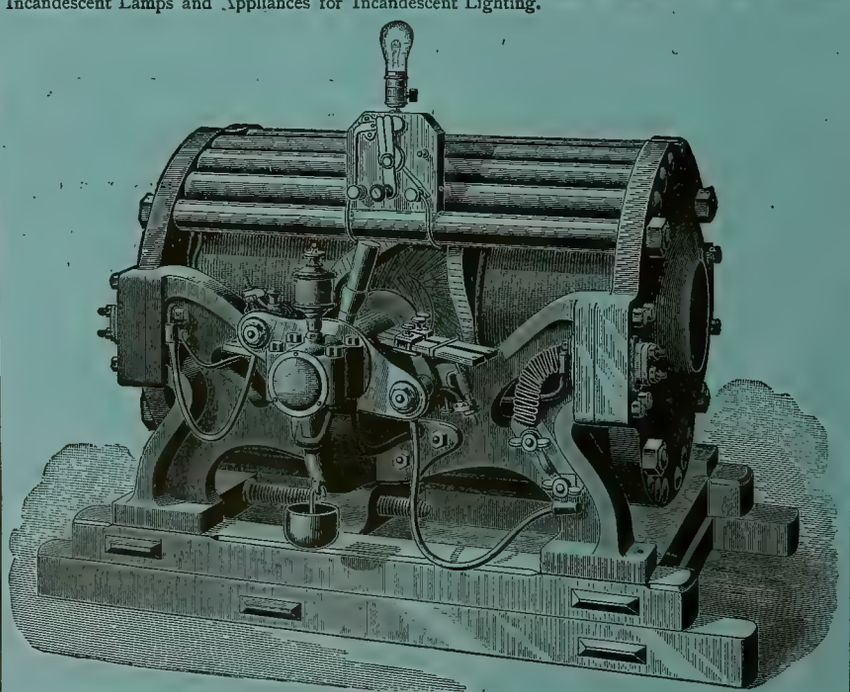
AND ALTERNATING CURRENT **LONG DISTANCE INCANDESCENT LIGHTING.**

These dynamos are automatic in their regulation and will maintain a uniform light, with all or any portion of the lights in circuit. Our lamp will not blacken, and will maintain its candle power during its guaranteed life. Every requisite for the most perfect system of Incandescent Electric Lighting, at prices which insure a profitable investment to the purchaser. Incandescent Lamps and Appliances for Incandescent Lighting.





This company also manufacture Electric Motors of all sizes for the transmission of power. Plans and estimates furnished for all kinds of Arc and Incandescent Lighting.

ALSO MANUFACTURERS OF

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

THE THOMSON-HOUSTON ELECTRIC CO.,

OFFICES:

Eastern, 178 Devonshire St., BOSTON. Western, Pullman Building, CHICAGO, ILL.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

MINNEAPOLIS, NOV. 17, 1887.

EDISON UNITED MANUFACTURING CO.,
65 Fifth Avenue, N. Y.

GENTLEMEN:

The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

U. S. OLD LAMP

IN GRAND OPERA HOUSE, MINNEAPOLIS.

WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of J. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=11$\frac{50}{100}$ per H. P.

EDISON 348 LAMPS REQUIRING 54 H. P.=6$\frac{44}{100}$ per H. P.

COMMENTS ARE UNNECESSARY.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, MANAGER. 216 LA SALLE STREET, CHICAGO.

THE NATIONAL CARBON CO.

CLEVELAND, O.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

The Parker-Russell Mining and Mfg. Co.

Electric Light Carbons

Adapted to all Systems.

CITY OFFICE,
711 Pine St.
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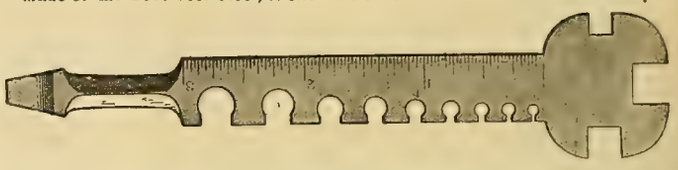
ELECTRICIAN'S POCKET TOOL.

Made of the Best Tool Steel, Nickel Plated and of the Finest Workmanship.



Comprises accurate Wire Gauge, either Birmingham or Edison Standards, French Millimeter and English inch comparative Scales, Screw Driver, Wire Cleaner or Pencil Sharpener, and Standard Wrenches, IN A NEAT CASE FOR THE VEST POCKET. PRICE $3.

CENTRAL ELECTRIC COMPANY,
38 and 40 LaSalle Street, - - - CHICAGO.

LAVA INSULATORS.

—ABSOLUTELY—

Fire, Water and Acid Proof.

MADE FROM MODEL IN ANY SHAPE.

Have stood several tests, can furnish highest testimonials from largest manufacturers of Electrical machinery in the world. Samples and estimates sent on application. Cheaper than any reliable insulation.

D. M. STEWARD M'F'G CO., Chattanooga, Tenn.

January 1st, 1888, we removed our entire plant from Cincinnati to Chattanooga, where we have greatly increased facilities in all departments.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

707 and 709 MARKET STREET, - ST. LOUIS.

BRANCH, 521 DELAWARE ST., KANSAS CITY.

Sawyer-Man Electric Co.

LICENSED BY AND SUCCEEDING TO THE COMMERCIAL BUSINESS OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

EDISON'S OPINION.

Geneva Non-Magnetic Watch Company:

Gentlemen:—During the past six months I have submitted the watches containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring to test in different fields of magnetism. I find them exempt from magnetic influence, however strong, and practically no retardation of the balance, nor change in rate occurs, even when in actual contact with Dynamos or powerful Electro-Magnets.

I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

For Full Information about the Watches referred to in the above Testimonial, address:

Geneva Non-Magnetic Watch Co.

(LIMITED.)

177 & 179 Broadway, New York.

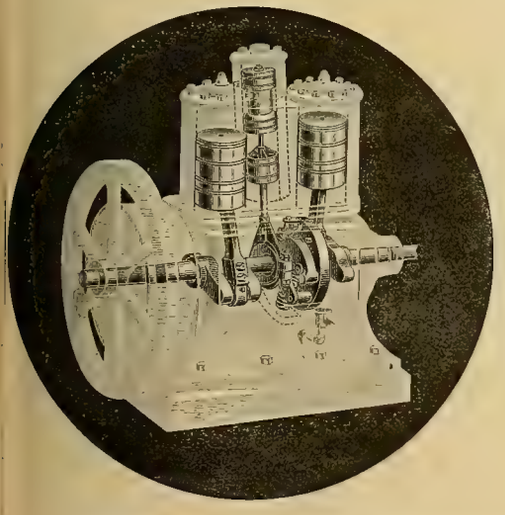
THE
ALTERNATING SYSTEM,

MANUFACTURED AND CONTROLLED BY

The Westinghouse Electric Co.

PITTSBURGH, PA.

LOW COST. LONG DISTANCE. HIGH EFFICIENCY.



The Single-Acting and Self-Lubricating Principles

Mark the second great advance in Steam Engineering, and represent the Highest type of

COMMERCIAL ECONOMY.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

SELLING DEPARTMENT
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Westinghouse, Church, Kerr & Co.
17 Cortlandt Street.....New York.
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302 and 304 Washington Ave.....St. Louis.
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259 South Main Street.....Salt Lake.
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ELECTRIC LIGHT CARBONS.

FARADAY CARBON COMPANY

PITTSBURGH, PA.

WESTERN ELECTRIC COMPANY,

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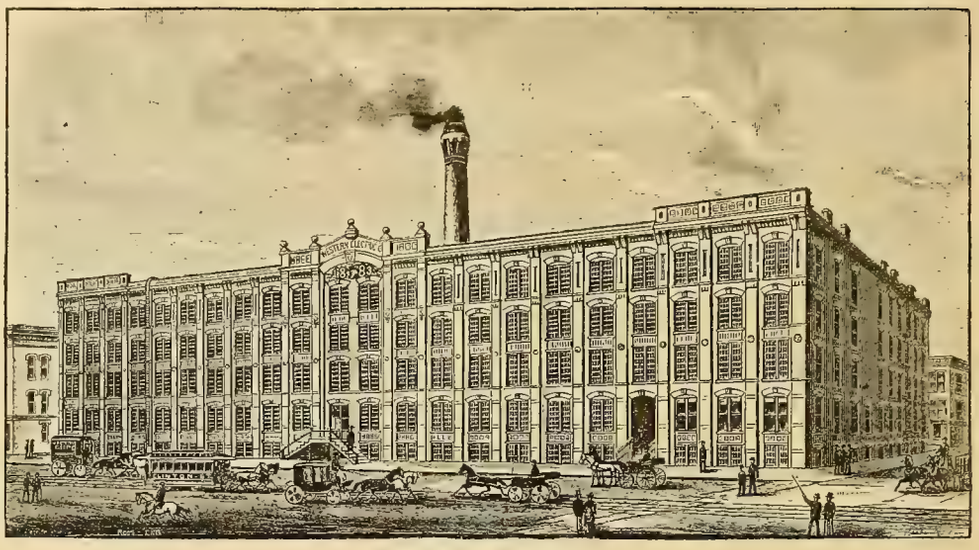
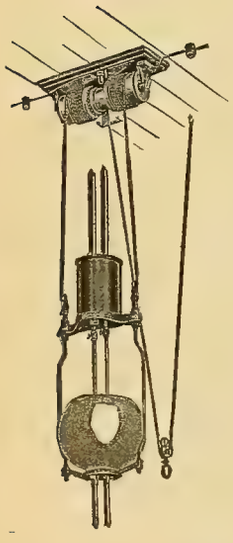
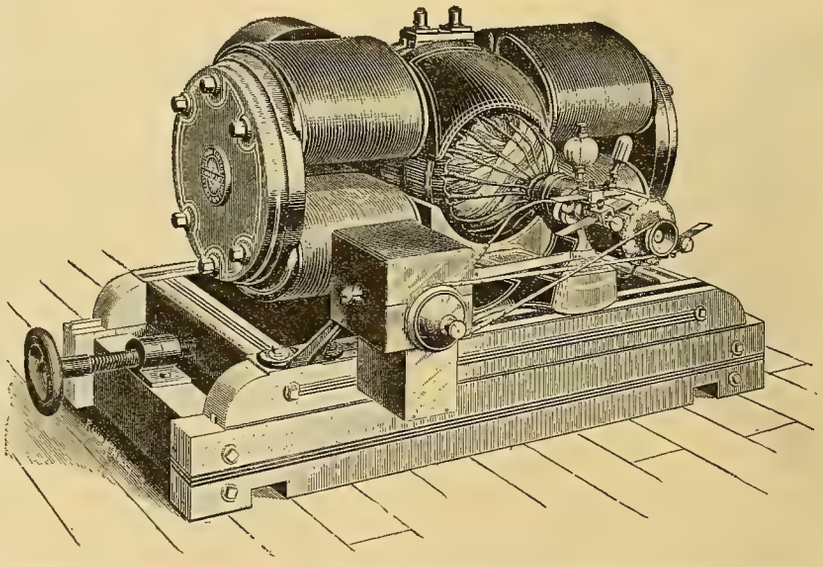


CHICAGO FACTORY.

Electric Lighting Apparatus

OUR SYSTEM OF ELECTRIC LIGHTING IS COMPLETE IN EVERY DETAIL, AND IS UNEXCELLED IN THE EFFICIENCY AND WORKMANSHIP OF THE APPARATUS, IN THE BRILLIANCY, STEADINESS AND COLOR OF THE LIGHT PRODUCED, AND IN AUTOMATIC REGULATION. WE FURNISH DYNAMOS TO GIVE ANY REQUIRED CURRENT. THE HIGH GRADE OF WORKMANSHIP AND THE EFFICIENCY OF OUR DYNAMOS





RENDER THEM SPECIALLY ADVANTAGEOUS FOR CHARGING STORAGE BATTERIES, FURNISHING CURRENT FOR ELECTRIC MOTORS, ETC. WE FURNISH ARC LAMPS ADAPTED TO ANY ARC CURRENT. THE SUPERIOR CONSTRUCTION AND SIMPLICITY OF OUR LAMP RENDER ITS USE ADVANTAGEOUS WITH ANY SYSTEM.

WE HAVE STILL A LARGE QUANTITY OF

KERITE WIRE,

Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even No. 16 gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes Nos. 13, 14, 15 and 16.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, FEBRUARY 4, 1888. No. 5.

The Menges Thermo-Magnetic Generator and Motor.[1]

We have received from M. Menges, of the Hague, a most interesting description of an apparatus on which he has been at work for some time past, with the object of generating electricity by the direct conversion of heat, or, as it might be more accurately described, by a more direct conversion than that of an ordinary dynamo. M. Menges' apparatus depends, like that of Edison, upon the fact that the magnetic metals lose their magnetic permeability at a certain temperature. It differs greatly, however, from its predecessor in important points, especially in the fact that it does not require the aid of an external source of motive power. In Edison's pyro-magnetic dynamo it will be remembered that it is necessary to provide some small amount of motive power from an extraneous source in order to revolve the shield by which the heat is alternately directed on one half or the other of the armature cores. M. Menges' apparatus is, on the contrary, wholly automatic.

We proceed to give a free translation of the description furnished us by the inventor. In attempting to employ the thermo-magnetic properties of iron or nickel in the construction of machines for the generation of electricity upon an industrial scale, we are met with the difficulty that the heating and cooling of large masses of metal not only involve great loss of heat but also requires much time; hence to obtain a useful effect of any importance it would appear necessary to employ machines of dimensions altogether impracticable. By the device and method of construction now to be explained this difficulty has, however, been completely overcome.

The action of a magnetic pole diminishes so rapidly with the increase of distance that it may suffice to remove the armature to a distance relatively small compared with its own dimensions, or with those of the magnet, in order to reduce the action to a negligible value. But if, the magnet NS and the armature A being at a certain distance, we bring between them a piece of iron or nickel, *d*, then the magnetic force upon A is immediately and very considerably increased. In modern language, the resistance of the magnetic circuit has been reduced by the introduction of a better magnetic conductor, and the number of lines of force passing through A is proportionately increased. The mass of the piece *d* may moreover be relatively small compared with that of NS and A. If *d* be again withdrawn, the magnetic resistance is increased, and the lines through A are again a minimum.

Now it is evident that we can also obtain the same effect by sufficiently heating and cooling the intermediate piece *d*; and again, with a broad field we can alter the distribution of the lines at will by heating or cooling one side of this piece or the other. For this reason we will call the piece *d* the thermo-magnetic distributor, or briefly, the distributor.

We will now describe the manner in which this principle has been realized in the practical construction of both a thermo-magnetic generator and motor.

Fig. 1 shows an elevation and part section of one of the arrangements employed. Fig. 2 is a plan of the same machine, in the latter the ring *a a* appearing on a higher plane than it actually occupies. NS is an electro-magnet, *a a* the armature, wound as a Gramme ring, and fixed to a frame with four arms, which can turn freely upon a pivot midway between the poles. The cross

Between the magnets and the armature is placed arms of the frame are attached at 1, 2, 3, 4, Fig. 2. the distributor *d d*, where it occupies an annular space open above and below. Both the magnets and the armature are coated on the sides facing the distributor with mica, or some other non-conductor of heat and electricity. The distributor is attached to and supported by the cross-arms, so that it turns with the armature.

The distributor is composed of a ribbon of iron or nickel, bent into a continuous zig-zag. This form has the advantage of presenting, in the cool part of the distributor, an almost direct road for the lines of force between the poles and the armature, thus diminishing the magnetic resistance as far as possible. At the same time the Foucault currents are minimised. To the same end it is useful to slit the ribbon, as in Fig. 3; this also facilitates the folding into zig-zags.

The distributor is heated at two opposite points on a diameter by the burners *b b*, above which are the chimneys *e e*. The cooling of the alternate section is aided by the circulation of cold air, which is effected by means of the draught in the chimneys *e e*. At the points of lowest temperature a jet of air or water is maintained. The cross-arms are insulated with mica or asbestos at the points where they extend from the armature to the distributor.

It will now be evident that while the distributor is entirely cool many of the lines of force pass from N to S without entering the armature core; but if heat is applied at the points 1 and 2 in the figure, so as to increase the magnetic resistance at these points, then a great portion of the lines will leave the distributor, and pass through the armature core. Under these conditions, so long as heat is applied at two points equidistant from N and S, we might, if we so pleased, cause the armature to be rotated by an external source of power, and we should then have an e. m. f. generator in the armature coils, that is to say, the machine would work as an ordinary dynamo, and the power expended in driving the armature would be proportionate to the output.

Suppose next that the points of heating, and with them the alternate points of cooling 90 degrees apart, are shifted round about 45 degrees, so that the two hot regions are no longer symmetrically situated in respect to each pole of the field. The distribution of the magnetization has therefore become unsymmetrical, and the iron core is no longer in equilibium in the magnetic field. We have, in fact, the conditions of Schwedoff's experiment upon a larger scale, and if the forces are sufficient to overcome the frictional resistance a rotation of the ring ensues in the endeavor to restore equilibrium. The regions of heating and cooling being fixed in space, this rotation is continuous so long as the difference of temperature is maintained. The ring in rotating carries with it the armature coils, and of course an e. m. f. is generated in the same way as if the motive power came from an external source. In this respect the machine therefore resembles a motor generator, and the rotation is entirely automatic.

The armature coils are connected with a commutator in the usual way, and the field may, of course, be excited either in shunt or in series. M. Menges says that the residual magnetization is sufficient in his machine to start the rotation by itself.

When the machine is to be used as a motor it is evident that the windings on the armature core need only be sufficient to supply current to excite the field, or by the use of permanent magnets they may be dispensed with altogether.

M. Menges has further designed a large number of variations on the original type, varying the arrangement of the several parts, and employing armatures and fields of many different types, such as are already in use for dynamos.

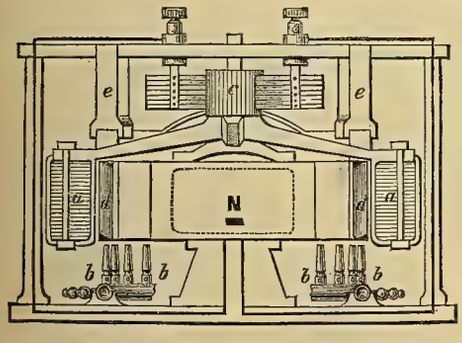


Fig. 1.

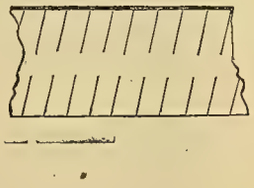


Fig. 3.

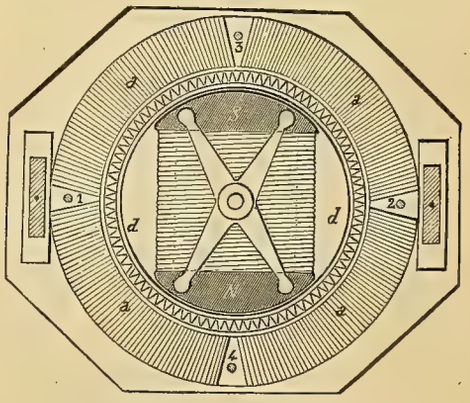


Fig. 2.

1 *London Electrician*, January 13th.

In Fig 4 a machine is represented in which the field is external to the armature.

In Fig. 5 we have a thermo-magnetic generator, which corresponds to the disk machine in dynamos. Similar parts are indicated by the same letters in each of these figures, so that no further detailed description is necessary.

In another modification M. Menges proposes to rotate the burners and leave the armature and distributor at rest. But in this case it is evident that the e. m. f. produced would be much less, because the magnetization of the core would only undergo a variation of intensity, and would nowhere be reversed, except, perhaps, just in

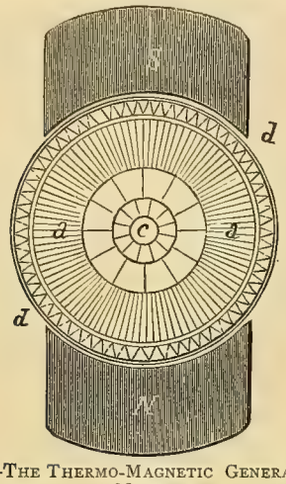


FIG. 4.—THE THERMO-MAGNETIC GENERATOR AND MOTOR.

front of the poles. In machines modeled on the Brush type it is evident that the distributor need not be continuous.

Enough has, however, been said to indicate the extent of the field upon which the principle may be applied.

Motors for Small Powers in Chicago.

Up to the present time the use of motors for small powers in Chicago has not been as extensive as might have been expected. There is, it is true, a number of small motors running, but they are run for the most part in connection with isolated electric light plants. The main impediment in the way of an extensive adoption of small motors has been the lack of current. The Chicago Arc Light & Power company last spring acquired possession of a number of independent arc lighting stations, and have been hard at work for months consolidating these stations, and as far as possible combining them into one central station at the corner of Washington and Market streets. A large part of the time, this station and their stations in other parts of the city have been taxed to their capacity to furnish the demands for arc lights. Work has gone forward steadily on their main plant, however, and within a short time their equipment will be such as to meet all demands made upon it. At present they are lighting about 1,300 arc lamps.

The Edison central station on Adams street is progressing slowly. The building is not completed yet, and it will be some time before the station is ready to supply current for lights or motors.

Last summer the city authorities forbade the use of motors on arc circuits inasmuch as one or two persons had been injured or killed while placing motors in arc light circuits.

The lack of current, either arc or incandescent, and this edict of the city authorities thus conspired against the introduction of small motors. But the Chicago Arc Light & Power company is now ready to furnish current for arc motors, and the edict of the city authorities has been modified to the extent that motors can be used in circuits that supply current for power alone, and not for lighting; consequently the Chicago Arc Light & Power company has agreed to run power circuits on the condition that each circuit should take fifty horse power. Territory will be assigned to each representative of manufacturers of arc motors who applies, and a circuit will be run for motors of that manufacturer, provided, as stated, the circuit calls for 50 horse power. As far as motors for arc circuits are concerned then, the prospects are brighter than they have been for some time, and we believe that motors for use on incandescent circuits will find a great demand when once a central station is established.

The Baxter electric motor is the first introduced under the new order of things. Kittredge & Friott, printers, at 74 Market street, have placed a one horse power motor in their establishment, and at present it is running three small but heavy presses, and is not working to its capacity by any means. The motor stands upon a framework at a window overlooking the river, and consequently in a position free from dust. It will be boxed in, leaving only the switch exposed, while the instructions to the employes are exceedingly simple, brief and to the point: "Do not touch," or words to that effect. The motor was set in operation at seven o'clock last Thursday morning, and its noiselessness, smoothness of running, freedom from heating and automatic regulation were so marked as to command attention and praise. The regulation, shown by throwing presses into or out of operation, was well-nigh instant. A two horse power motor has been ordered by the Arc Light & Power company for use at their station.

The scale of charges to be made by the Chicago Arc Light & Power company for current is based upon the charge of $100 per horse power per annum. For one-eighth horse power per annum the charge will be about $15 per annum; while for ten horse power, the charge will be about $90 per horse power per annum.

Death of Gen. John L. Thompson.

The news of the death of General John L. Thompson of Chicago, will be received with great sadness by those who were acquainted with that estimable gentleman. January 28th, he was stricken with paralysis as he was arising in the morning. Physicians were summoned and under their treatment General Thompson made such progress toward recovery, that Monday evening last friends were hopeful of a return of health. But Monday night there was a change for the worse and death occurred Tuesday morning. Had the general lived until the succeeding day he would have been fifty three years of age. He leaves a wife and two children of sixteen and fourteen years of age respectively.

General Thompson was born in Worcester, Mass., and came to Chicago early in the '60's. He abandoned law studies when President Lincoln called for 75,000 volunteers and enlisted as a private. His health soon broke down and he went east to New Hampshire, but subsequently returned to the seat of war and served with such ability that he was promoted to the position of brigadier-general. At the close of the war he returned to Chicago and finished his law studies, and of late years he has been well known in connection with the law firm of Williams & Thompson.

General Thompson was a genial courteous gentleman who will be missed by a host of friends. Only a week before his death he had been honored by election the to presidency of the Union League club.

General Thompson had been for years interested in the development of electrical interests. He

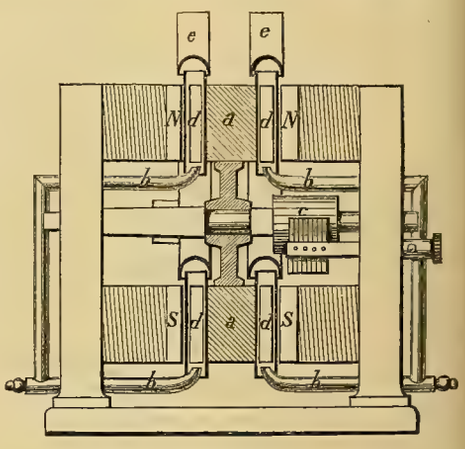
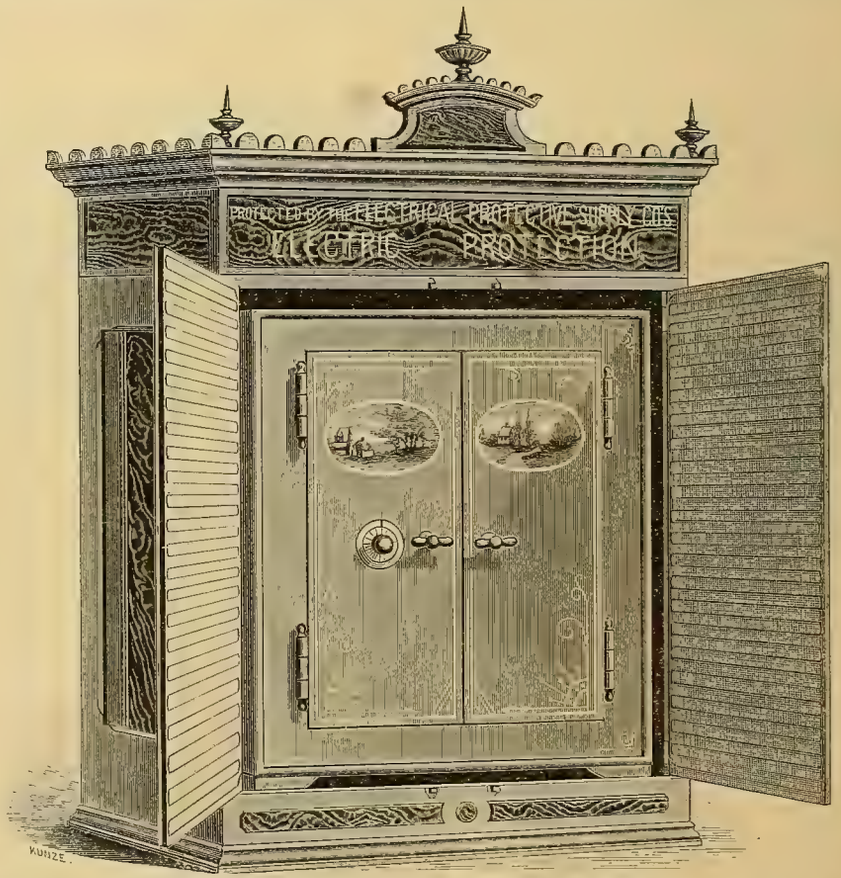


FIG. 5.—THE MENGES THERMO-MAGNETIC GENERATOR AND MOTOR.

was a stockholder in the Western Electric company, a stockholder in the Chicago Telephone company, was also interested in the Chicago Edison company, and the law firm with which he was connected have been for years the attorneys in Chicago for the Western Union company and the American Bell company.



The Wallace Electric Cloth Lining.

In a recent number of the WESTERN ELECTRICIAN the construction of the Wallace electric cloth lining was shown. In connection two illustrations are given of methods of applying the lining, in one case to a cabinet inclosing a safe and in the other case to the inside of a vault. The lining as has been shown is so made that any burglarious tampering, however slight, a fire or even the dripping of a few drops of water

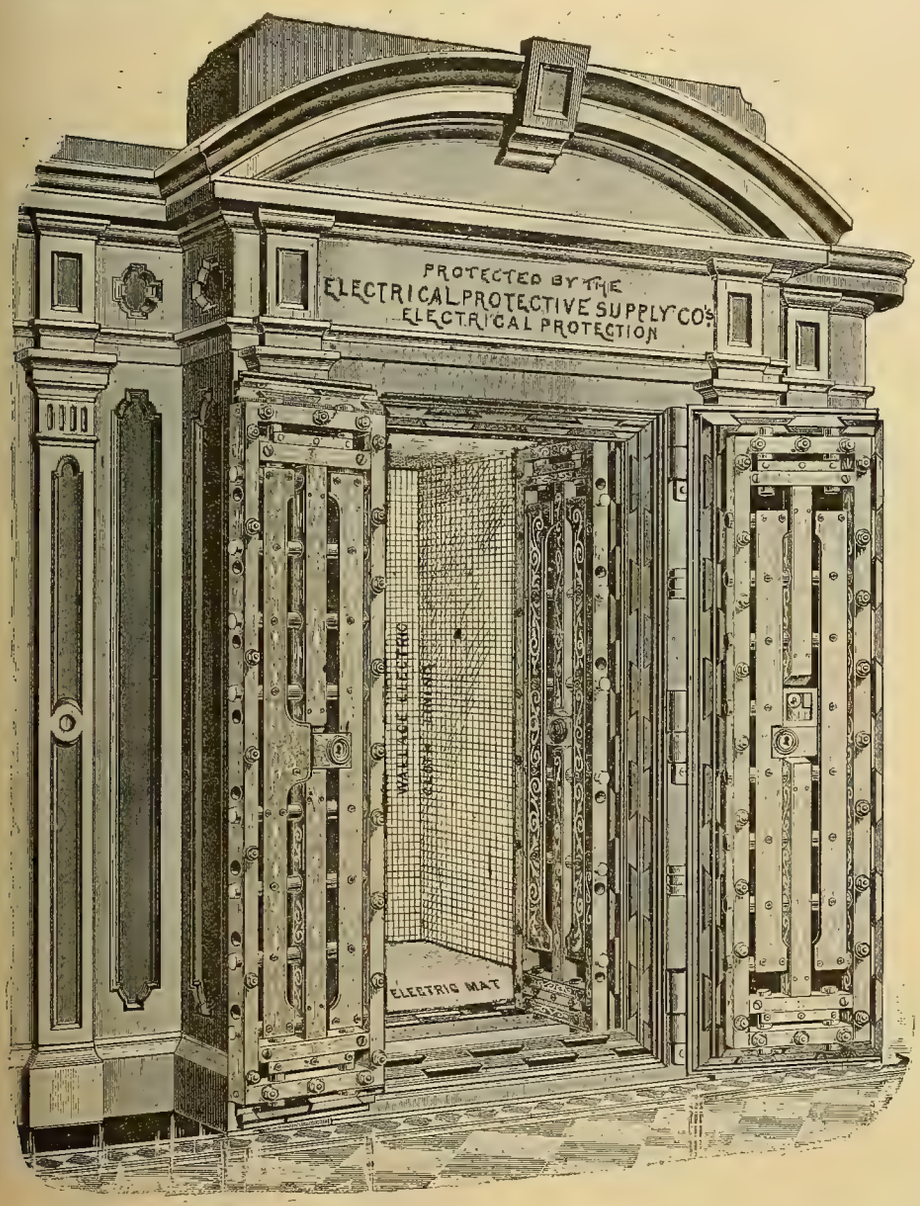
upon it will cause an alarm to be sounded and if this alarm is given in a central station, at once a watchman or patrolman will respond to inquire into the cause. As a system, the whole is very complete.

The Electrical Protective Supply company, of Chicago, control the sale of this lining.

Apparatus for Electrolysis of Water.

T. O. Sloane, Ph. D., describes, in a recent number of the *Scientific American*, a simple apparatus designed to show the rate of consumption of water by electrolysis. In the ordinary apparatus the collection and measurement of the gases is provided for, but no means of observing the rate at which the water disappears, so that considerable time must elapse before the decrease of volume becomes perceptible, but by the familiar method adopted in the construction of thermometers, of connecting a fine tube with a bulb, the rate of consumption can easily be observed.

A standard, with movable rings, attached by thumb screws, like that of a retort holder, supports vertically two glass tubes, one of which is an ordinary thistle tube about six inches long, with a bulb and a tube dependent from it of about $\frac{1}{32}$ of an inch bore, the other a decomposing tube about 12 inches long, with bulbs at the top and bottom, each about two inches long and $\frac{3}{4}$ of an inch in diameter, connected by a tube about four inches long and $\frac{1}{32}$ of an inch bore, to which is attached a scale four inches long with $\frac{1}{8}$ of an inch subdivisions. A flexible rubber tube connects the lower end of the thistle tube with the lower bulb of the decomposing tube, and this bulb is closed from below by a cork, preferably of india rubber, through which two strips of platinum foil project into the bulb and are connected externally with the wires from a battery. Water acidulated with sulphuric acid is poured into the thistle tube and passes thence into the decomposing tube, air bubbles being eliminated by raising and lowering the tubes. When the water in the decomposing tube has risen to the top of the scale, and stands at the same level in the thistle tube, its level in the latter tube is indicated by an ink mark, connection being made with the battery, the water is decomposed, and the gases rise in the decomposing tube, and escape from its open end above, or may be collected if desired. As the water is decomposed, its descent in the fine tubes is comparatively rapid, and may easily be observed, and the amount decomposed in a given time measured by the scale and the mark on the thistle tube.



Death of Professor Raynaud.

The death of Professor Raynaud, director of the school of telegraphic operators, Paris, France, January 10th, at the hands of one Milmaud, is recorded. It seems that the assassin Milmaud was in the employment of the post office and had invented certain improvements in electric telegraphy in conjunction with a fellow employe, M. Baudot. They patented the device — whether jointly or separately does not appear. The matter came to litigation and Milmaud was unsuccessful. Professor Raynaud as one of a committee appointed to investigate the claims of Milmaud, signed a report refusing the demands of the latter, namely, 60,000 francs for the payment of his debts, 40,000 francs for his expenses, and the decoration of the Legion of Honor. This action on the part of Professor Raynaud was considered sufficient provocation by the murderer to take the life of the former by shooting him. The victim of the outrage received two shots, the one in his right arm, from which nothing was feared, and the other, which proved fatal, in the loins.

Milmaud's history shows him to be a man of ungovernable temper and very free in the use of the revolver. For instance, in July, 1886, being enraged that M. Cochery, the former postmaster-general, did not support him he fired three shots with a revolver at the pupils of the ecole polytechnique because the son of Cochery was among them, and wounded MM. Guérin and Pigeaud.

The Electric Light Under Water.

When it was discovered that an artificial light that very closely resembles the natural light of day could be procured from electricity, and that it could be so easily provided as to take, in a great measure, the place of gas for lighting purposes, everybody was naturally astonished and thought that the electricians were the greatest men on earth, says the New York *Sun*. The new system was hardly old enough to be an assured success before a lot of wise men began considering the advisability of devoting this light to a greater purpose than that of merely lighting up the humdrum affairs of every-day life.

As an experiment, a small incandescent light was thrust beneath the water in a fountain. The effect was superb while it lasted, but the water managed to work its way into the globe and the light was extinguished. This gave the electricians something to think about, and they began immediately to rack their brains for a means of keeping the water away from the source of light. A coating of rubber was finally placed over the joint where the glass globe joins the brass holder, and over this was drawn a rubber bag that fitted tightly over the top of the globe and around the pipe through which the wire passed. This promised to be successful, but a brief experiment showed that the glass was not strong enough to stand the pressure of water, and, after being exposed to it for a short time, would collapse. A globe was then made of plate glass that proved able to stand the strain.

For some time this was only used in lighting up fountains by way of an ornament. Then it occurred to Professor Baird of the United States Fish commission that if a light could be used under water it would prove of great advantage to him in his search for fish that never allowed themselves to be caught by any of the old-fashioned methods. He believed that there existed at a great depth in the ocean various kinds of fish that had never been seen. Every boy who has ever lived near the water knows that a favorite method of catching eels is to lure them within spearing distance by a bright light placed in the bow of a boat. Light not only attracts eels, but nearly everything else that lives in the water, and the professor was sure that if a light could be made to live at a great depth in the water the reward would be great.

The steamer Albatross of the commission was provided with an engine and a dynamo. A liberal supply of heavy glass globes that would hold a light equal to the lighting power of 100 candles was placed on board, and, equipped with other necessary articles, such as a lot of insulated wire, a large quantity of light, strong rope, and a number of heavy weights to serve as sinkers, the steamer started out. The first attempt was unsuccessful, for at a depth of 1,000 fathoms the pressure was so great upon the globe that it broke. Another trial was speedily made with heavier globes, and they were found able to stand the pressure of any depth to which they could be sunk. But the most wonderful part of this trial trip, which took place something like three years ago, was related to Secretary Frank S. Hastings of the Edison Electric Light company by Professor Baird.

At a point near the Bahamas, according to the professor, the light was dropped overboard and sunk by means of heavy weights to nearly 1,000 fathoms below the surface. On the deck of the vessel stood the crew with nets ready to drop them under the fish that were lured from their homes in the great depth. The light was allowed to remain in the water for some time, and then it was slowly raised. It looked like the reflection of a star in the water at first, and its rays were seen, and in them were visible the forms of darting fish. The light soon lit up the water for

twenty feet around, and a weird assortment of fish that had never before been heard of was seen. When near the surface the entrails of some of these fish burst from their mouths. "The professor ascribes this," said Mr. Hastings, "to the inward pressure. Nature had made them so that they could live in the great depths in which they were found, and when this pressure of the deep water was removed there was a counteracting force that killed them."

The dead fish were just as useful for the purpose for which the professor wanted them as live ones, and he gathered in a great many rare and curious specimens without much trouble. The light was also used to good purpose for discovering the various depths in which different kinds of fish live. The cost of fitting up a steamer with the necessary apparatus to produce electric light is about $1,500, but this first cost would be counterbalanced by the cheapness of the light it would produce. The cost of light, roughly estimated, would not be within one-sixth as much as the cost of the usual method of lighting.

The United States torpedo station at Newport is experimenting with electricity in order to expose by its rays any obstruction that might lie in the path of a vessel. The experiments have reached that point where it is certain that the water can be readily illuminated for a space sufficiently great to show a passage for a vessel. The difficulty is in regard to the propelling of this light at a distance sufficiently far ahead to enable a vessel to swerve from its course or come to a full stop before striking a revealed obstruction. The idea of these experiments is to show, in times of war, explosives that lie beneath the water. The thrusting of a glass globe through the water at the speed at which a steamer usually moves is an operation requiring considerable thought for its successful achievement. There is always much difficulty in lighting up water that has a ruffled surface, and for this reason many of the experiments made have been less successful than was expected. The lighting up of oyster beds, Mr. Hastings thinks, could be readily accomplished, because the water in these places is not apt to be very deep. In the West Indies and the Bahamas, where valuable shells and sponges lie deep in the water, the searchers after these articles have a box with a glass bottom. The top is open. In the box is placed a lamp, and then the glass bottom is pressed down in the water until it is slightly below the surface. The water directly below the box is perfectly smooth, and it is possible to see through the water for nearly ninety feet. Mr. Hastings thinks that this same system could be adopted with the electric light, which would throw a stream of light much stronger than could be obtained by any other means. Early in the present month a boy was drowned at Winchendon, Mass. Two days later his body was discovered by means of an electric light that was thrust under the water by a pole. In the clearing and raising of wrecks the electric light, it is thought, will be of great value.

"It has been discovered," said Mr. Hastings, "that an electric light placed in a barrel of new whiskey and left there for forty-eight hours will give it the color and flavor of whiskey five years old. I can't attempt to explain it, but this method of treating whiskey has been in practice for a year or more. The light, as I understand it, absorbs the fusel oil."

The government officers on Staten Island started in a short time ago to experiment in lighting buoys with electricity. The scheme has not been perfected yet, and so some doubts remain as to whether or not it will be successful. In large factories, where the air is likely to be charged with explosive gases, the light is sometimes produced by incandescent lamps inclosed in glass boxes that are filled with water. In case the glass globe breaks, the water extinguishes the spark instantly. In many oil refineries, where it has heretofore been found impossible to use any kind of artificial light, electric lights have been successfully introduced. The electric light is now used in many theaters, and is a good thing for the actors and actresses, because it is so near the natural light of day that but little painting of the face is necessary. Many dentists use tiny globes of light to examine their patients' mouths, and physicians have used the same kind of light in examining various portions of the human anatomy.

Irish's Telephonograph, or Speech Recorder.

By W. E. Irish.

The telephonograph is an instrument for recording in legible characters, more especially articulated and musical sounds. It consists essentially in an arrangement of a flexible diaphragm to receive the impact of sound waves, which, vibrated by such impact, causes vibrations of the diaphragm that governs an ink discharging pen, or electrical discharging point, a movable ribbon of paper being arranged to receive the discharge of the pen, whereby legible characters are recorded, representing the articulated or other sounds, as the case may be, received by the primary diaphragm.

The depending hollow pen is suspended from a second thin flexible diaphragm, so as to render the pen more sensitive in its lateral or vibratory movements. A vibratory rod connects the pen with the primary diaphragm, so as to cause the pen to vibrate in unison with the diaphragm. The pen is connected with the ink reservoir by means of a flexible tube. The ink reservoir discharges a continuous jet of ink through the pen whenever the instrument is put in operation. The ribbon of paper, having uniform motion imparted to it by clockwork, is caused to pass just under the pen so as to receive the jet of ink as it is discharged. When the apparatus is ready to receive or transmit, but the primary diaphragm is not vibrated, the ink makes a straight line on the paper. On the vibratory movement of the diaphragm, the pen moves substantially at right angles to the paper, describing a figure on the paper, corresponding to the sound actuating the diaphragm.

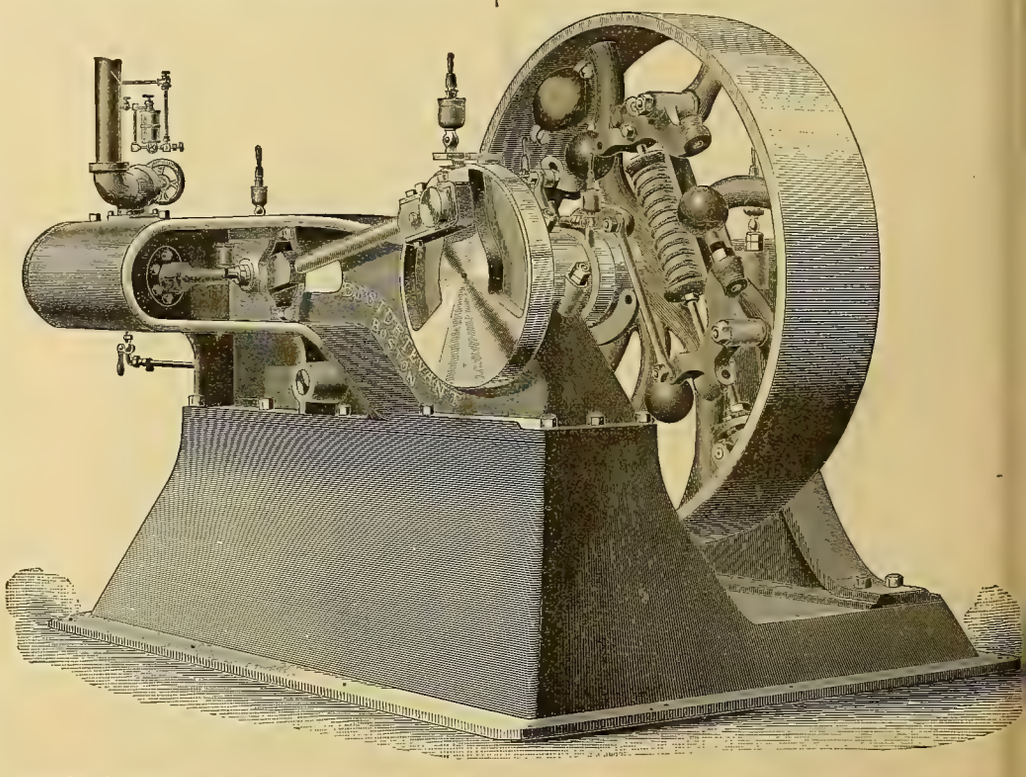
These figures always have the same character relative to the sound waves discharged upon the primary diaphragm. They are legible, and may be learned as other characters. This instrument records the spoken thoughts of men, and saves them the drudgery of the pen. It may be connected to a telephone where it will record all that is said. The listener, while hearing the words spoken at the other end, can see them being recorded.

The business of the Long Distance Telephone company continues to increase at a remarkable rate. New York correspondents of Boston and Philadelphia papers now use the telephone largely instead of the telegraph for transmitting press despatches.

The Sturtevant Automatic Engine.

An engine that is rapidly taking the front rank among the prominent electric light engines is that built by B. F. Sturtevant, of Boston, Mass. It has been gradually developed in other fields until it now enters the arena of electric lighting a perfect engine for its work. The manufacture of engines was first entered into many years ago by B. F. Sturtevant, who is well known as a manufacturer of blowers, in order to satisfy the demands of his customers, who desired for fan propulsion, a stiff, compact and economical engine, capable of perfect regulation. The high speed at which a blower must be run, and the continued service required of the engine, present conditions similar to those attendant upon dynamo driving.

By continued experiment and careful designing, engines have been developed that are remarkable for their combination of simplicity, compactness, durability, stiffness, economy, and perfect regulation; although they are manufactured in great variety to meet the varied requirements of different shapes, sizes and location of fans, only one general style has been introduced for electric lighting work. The cut in connection represents the simplest type of this class, namely the single valve, automatic horizontal engine.



The valve is of the balanced piston type, accurately ground to a fit, and provided with an ingenious contrivance, whereby all danger from water in the cylinder is avoided. Motion is derived through a rocker, from a single eccentric which is pivoted to the governor wheel, so that a change in the position of the weights causes the eccentric to be swung across the shaft, varying the points of cut-off and compression and accurately governing the speed of the engine. The governor wheel, which also serves as a band and fly wheel in the smaller sizes, contains four weights acting by an increase of speed to compress the springs. The point of cut-off is thereby susceptible of change from zero to seven-eighths. The heavy weights, the stiff springs and the balanced, frictionless valve combine to make the governor excessively sensitive to the least change in the load and speed; but too sudden action on its part is prevented by a dash-pot connected with the system of weights and springs. Briefly summarized, the important features of this type are, the perfectly balanced piston valve, straight steam ports with large area, careful distribution of weights in the reciprocating and revolving parts, the overhanging cylinder, the perfect regulation and high economy, and a frame with the metal properly distributed along the lines of steam. The engine is provided with ample bearing surfaces and superior oiling devices, thus

guaranteeing cool bearings, at high speeds. The self-contained bed of this type produces a natural positive alignment of parts.

The large sizes of this class are similar to this in general appearance but differ principally in that they have an independent governor and fly wheel, a separate outboard pillow block, and are provided with main and cut-off valves, driven by two independent eccentrics. Their most marked characteristic is a novel and peculiar form of riding valve almost frictionless, under the control of a very powerful governor on the crank-shaft, producing a remarkable regularity of speed.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number XXVIII.

The Jamin Electric Candle.—The loss of light from upward illumination with the Jablochkoff candle, and the lack of means for relighting automatically when accidentally extinguished led to the invention of electric candles free from these defects, among which we find the Jamin candle which is represented by Fig. 63.

Two carbons, k k_1, $\frac{1}{5}$ inch diameter, are suspended point downwards and surrounded below by a flat copper coil inclosed in a slight case of copper foil, g g g g, which is attached to an insulation slate, p p, through which the carbons pass. The carbons are inclined at a slight angle so as to bring their points together, k being fixed while k_1 is movable, and connected with a spring armature f by a pin s; the armature being attached to the case below and slightly separated from it above. The coil is included in the electric circuit with the carbons, and when the current passes the armature f is attracted and k_1 separated from k by the pin s a sufficient distance to form the arc; the carbons as consumed being lowered by a wheel train inclosed in the tube shown above. Should the light become extinguished, the current being interrupted, the attraction of t ceases and the retractile force of the spring brings the points of the carbons together, and renews the arc. A glass globe attached to p p incloses the lower part of the apparatus.

A pair of carbons lasts about two hours, and lamps are constructed with several pairs, and an arrangement by which, as each pair burns out, it consumes a fine brass wire which releases a spring

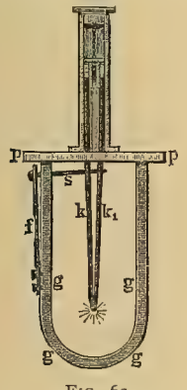


Fig. 63.

by which the current is instantly changed automatically to the next pair; so that lamps constructed with three candles burn continuously for six hours without attendance. This candle, like the Jablochkoff, requires the alternating current.

The Sun Lamp.—This lamp, invented by Clerc and Bureau, is illustrated by Fig. 64, and combines in its construction the arc and incandescent systems. To a metal frame g g is attached a block of marble or condensed magnesia M M M ⅜ to ¾ inch thick, through which the carbons k k are transmitted and by which also they are insulated; the form of the opening through which they pass being so shaped that as they slide down by their own weight, or that of weights attached above, as they are consumed, they are prevented from passing through, their points entering a cavity in which the light is produced.

They are attached above to the conductors d d, insulated as shown, and connected with the electric circuit L L. A primer connecting the points of the carbons establishes the arc, after which current is maintained through the block, which becomes a conductor by being heated between the carbon points. The arc is of exceptionally great length, varying from .39 of an inch to 2.36 inches, while in the ordinary arc lamp and Jablochkoff candle it is only $\frac{1}{16}$ to ⅛ of an inch in length. The luminous point is fixed, and the light remarkably steady. It is has a yellow tint when marble is used and is of great intensity, the light being largely due to the incandescence of the lime formed from the marble, while the magnesia block produces a white light. Marble blocks last for two lighting periods of about ten hours each, the durability being reduced by the heating and cooling with shorter periods.

The carbons vary in length from two to twelve inches and last about 15 hours.

The blocks vary in thickness according to the requirements of the light, being made thinner for short circuits and strong currents than for long circuits and currents of less volume and greater intensity. Those made of condensed

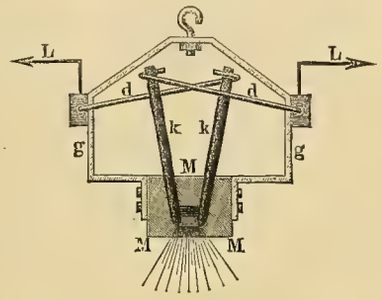


Fig. 64.

magnesia are more durable than those made of marble, being capable of lasting 100 hours.

The alternating current is preferred for this system, the lamp being closed to suppress the noise. The light is radiated downwards, but upward or horizontal radiation can also be obtained, springs being used to push the carbons. In another form of the lamp the carbons are placed horizontally, and have a special device for automatic relighting. The system is said to be economical, and the light, depending largely on the incandescence of the marble or magnesia, but slightly affected even by considerable variations of current strength.

Automatic Adjustment of Arc Light Carbons.—The automatic adjustment of the carbons is the main point in arc lamp construction, as upon this depends the production of the light, its renewal in case of extinction, and, to a considerable extent, its constancy and steadiness. This adjustment, consisting in separation and approach of the carbons, is actuated and controlled by the electric current which creates the light by various methods, as a train of clockwork, a break-wheel or clutch operated by an electro-magnet, or a solenoid. The applications of these methods are numerous and have led to the invention of an immense number of different lamps. If the adjustment of the carbons in a single lamp were the only requirement the problem would be comparatively easy, but the placing of a large number of lamps on one common circuit, and so regulating the resistance and the supply of current that each shall furnish an even steady light, without interfering with the others, is a far more intricate and difficult affair. This regulation of a number of lamps on a common circuit is accomplished by the method originally proposed by Hefner Von Altneck by which the regulating apparatus is placed in a shunt instead of in the main circuit, the shunt, which has a high resistance, causing the approach of the carbons, while their separation is produced by a coil of low resistance placed in the main circuit.

The length of the arc is a very important matter; if too long the intensity of the light as well as its constancy and steadiness is reduced, and the resistance abnormally increased. If too short, there is a decrease of intensity from insufficient resistance and a wastage of the current from too great conductivity, the light obtained being less than the current can furnish. The length of the arc must also be adjusted to the amount of illumination for which the lamp is intended, and it is found that for lamps of 1,200 candle power the most practical length is about $\frac{1}{16}$ of an inch, while for those of 2,000 candle power it should be about ⅜ of an inch.

The Foucault-Duboscq Lamp.—The first arc lamp with automatic regulation was invented by Foucault and subsequently improved by Duboscq, and was constructed with clock-work, operating by gearing two vertical racks connected with the carbon-holders, and controlled by an electro-magnet and opposing spring, in such a way that while the spring tended to bring the carbons together the current which produced the light, passing through the electro-magnet, attracted an armature which tended to separate them the carbons being placed vertically. The clock-work was operated by springs which required to be wound like those of a clock. Either the constant or alternating current could be used, the feeding forward of the positive carbon being proportional to its increased consumption with the constant current.

The Serrin Lontin Lamp.—The construction of this well known lamp, invented by Serrin and improved by Lontin, will be understood from Fig. 65.

The carbons, not shown, are placed vertically in the usual manner and connected above with with the holders n and n_1 n_2 the upper + carbon with n, and the lower — carbon with n_2 which moves vertically inside of n_1. A rack connected with n engages a gear-wheel r to which is attached a wheel s with which is connected a chain which passes over a pulley and is attached to a support t, connected with the holder n_2; hence as n descends by its weight it raises n_2 and the carbons approach each other.

A frame a b c d hinged at a and c but having a free vertical motion at the side b d, is connected with the clock-work by the gear-wheel r_1, and kept in equilibrium by three spiral springs, two below and one above, a transverse bar connecting it with the support t. A detent z, attached to this frame, releases the gear-wheel r, permitting the motion of the clock-work which brings the carbons together as described, in consequence of which a slight lowering of the frame occurs, and the detent z stops the clock-work. An electro-magnet e, placed in circuit with the carbons, attracts an armature a, connected with the frame, when the current passes, drawing down the frame, and the holder n_2 connected with it, separating the carbons and establishing the arc. If the arc becomes abnormally long the increased resistance reduces the current and lessens the attraction of the armature, the springs raise the

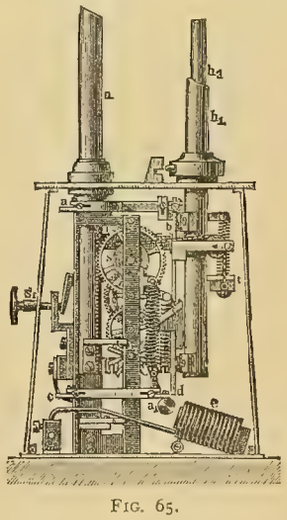


Fig. 65.

frame, pushing up the lower carbon, and the detent being at the same time released, the clock-work is put in motion and the carbons brought closer together. By this series of adjustments the arc is maintained at its normal length. By a screw s_1 the pressure of the lower springs is so adjusted as to produce the requisite equilibrium. By a proper adjustment of the gear-wheel r and the wheel connected with it the arc is adjusted to the required length. The current may be either constant or alternating.

Stockton, Cal., will be lighted by electricity on and after the 1st of April, contracts to that effect having been signed and the proper bonds filed.

The Thomson-Houston plant of 860 incandescent and 56 arc lights in the Union depot in Chicago has been put in operation.

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AT the meeting of the city council of Chicago last Monday evening the Inter-State Telephone company offered to furnish telephones at the rate of $60 a year per telephone, provided it was given the same privileges and immunities now enjoyed by the Bell company.

THE question of a postal telegraph has assumed such proportions that the committee on post-offices and post-roads of the United States senate has appointed a sub-committee on bills relating to the subject. The sub-committee is composed of senators Sawyer, Chace and Saulsbury.

READERS interested in the theory of electrolysis will find a short paper on that subject in this issue by R. Snowden under the head of "Electric osmose and capillary attraction," recently read before a committee of the British association. The electrician who desires to be thorough can not afford to neglect any department of electricity because it may not happen to be that in which he is immediately interested. Thorough knowledge can be attained only by studying a subject in all its bearings, and the investigation of the physical facts in one department sheds light on those in some other department. The movement of the ions in electrolysis may seem very remote from electric lighting or telegraphy, and yet it may give the investigating electrician the long sought cue to some important development in electric action in that department in which his work lies.

THE financial circular of Dow, Jones & Co., of New York city, dated January 26th, has the following statement about the telephone question now before the supreme court: "A dispatch from Washington states that one of the justices of the supreme court said yesterday that the telephone decision would be rendered before the court adjourned on February 20th, and that the rumor that the decision would be off on any side issues was not true, but that the issue made on the breadth of the patent and whether Bell or Drawbaugh was the first and original inventor would be squarely met and settled, and an elaborate opinion, passing upon and determining these issues, was in preparation which might astonish one side or the other, but would leave no ground for complaint by either side as to the beliefs and meaning of the court on the questions at issue. The feeling in Washington is that the Bell will be defeated on the broad issue of the patentability of the invention."

In taking cognizance of the foregoing rumor, the WESTERN ELECTRICIAN has only to repeat what it has said heretofore, that supreme court justices rarely gossip in advance about what their decisions will be, and that it is almost beyond comprehension, with the precautionary measures taken to guard the secrecy of deliberations in regard to the telephone decision on account of the great interests at stake, that any justice should have let information of the character outlined reach newspaper men. It is to be hoped, however, that the scope of the decision will be as broad as indicated.

THE death of Professor Raynaud, director of the school of telegraphic operators of Paris, France, is recorded elsewhere. An eminent electrician and scientist, whose name was known throughout his native land, is suddenly stricken down in the very prime of life by an assassin, who had recourse to the fatal bullet to satisfy his revengeful feelings against a man who, forsooth, had signed a report, refusing demands which, it would seem, had no foundation in equity. The French papers state that Milmaud was not a "vulgar murderer." It would seem not. But an account of his past life shows that he was a man of ungovernable passion and quick to bring the revolver in to play as ameans of redressing alleged wrongs.

Director Raynaud will be missed, not only in his country, but in scientific circles in other parts of the world. In addition to the formal title of engineer, which in France can not be assumed at will, he was doctor of physical science, licentiate in the mathematical sciences and in law, a member of the technical commission and of the consultative commission of posts and telegraphs. He was also an officer of the legion of honor, a professor of the polytechnic school, and was a member of the conference on electric units. He was only 44 years of age, and he leaves a young widow to mourn his loss.

THE fire in the Calumet & Hecla copper mine is still unsubdued, but last Monday preparations were under way to send twenty-five tons of concentrated ammonia down into the shaft, with the hope of extinguishing the flames.

Meantime the copper market is characterized by great activity, and heavy trading. On the New York metal exchange, Monday, a million and a half pounds of copper changed hands. When the trading opened long futures were in demand, and 250,000 pounds for June and July delivery were taken at $16.65. In addition to this sale some 500,000 pounds were taken on February delivery at $16.50. The latter purchase is believed to have been made for new export orders. Subsequently, $16.55 was bid for spot, which sellers held firm at $16.75. March changed hands at $16.75 to $16.85, April at $16.85 to $16.90, May at $16.90 and June and July at $16.75. The market closed at high-water prices. The London exchange cables of the same day, reported a big jump in copper, an advance from £73 15s. to £75 for spot. Chili bars opened strong, in consequence of a confirmation of the report of the French syndicate's acquisition of more than 95 per cent. of the production of the Rio Tinto, Tharsis, and Mason & Barry mining companies Spanish mines. The annual production of these three copper mines is about 45,000 tons, and the total Spanish production is less than 48,000 tons.

London estimates place the annual production of copper controlled by the syndicate at 150,000 tons.

A BILL to regulate commerce carried on by telegraph was introduced by Senator Spooner in the United States senate on the 25th ult. In many respects the bill is similar to the inter-state commerce bill as applied to railroads. A summary of the provisions follows: The bill applies to persons or corporations engaged in inter-state telegraphy or in telegraphy between a foreign country and the United States. It declares that all rates shall be reasonable and just and forbids discrimination of any sort against persons or places or against other telegraph companies. It forbids the formation of pools and the allowance of rebates or special rates. Telegraph companies are also required to publish their rates and file a copy with the inter-state commerce commission, and also to give the commission ten days' notice of proposed changes. Telegraph companies violating the provisions of the bill shall be liable to the persons injured thereby for damages, which may be recovered either by suit before the commission or the courts. In suits for damages the telegraph company is required to produce its books and its officers are required to answer any questions propounded to them, no matter whether of a criminating nature or not, but their testimony shall not be used against them in any criminal case. The remaining sections of the bill give the inter-state commerce commission jurisdiction over inter-state telegraph business, fix penalties for violation of the act, authorize the commission to inquire into the business of telegraph companies, and to investigate complaints under substantially the same provision that complaints alleging infractions of the inter-state commerce law are now examined into by the commission.

IN another column will be found a short article on the theory of the electrophorus. This simple instrument is always interesting to the student of electricity, and has given rise to so-called explanations, more difficult to comprehend than the instrument itself. The theory advanced in this article is substantially correct, and may be briefly summarized as follows:

The instrument consists of a sheet of hard rubber, placed between two metal sheets, the lower one called the sole and the upper one the cover; the cover being removed, and the hard rubber beaten with fur, the rubber receives a negative charge, and the fur a corresponding positive charge; the sole at the same time becomes positively charged by induction, and the cover being replaced and a connection made between it and the sole, the greater part of the positive charge passes from the sole to the cover; the cover being now lifted off by the insulating handle, parts with its charge on the approach of an external body. Meantime, the inductive influence of the cover being removed, the negative charge on the rubber attracts a positive charge to the sole as in the first instance, and the same series of manipulations may be repeated with the same results, indefinitely, the intensity of the original charge given by the fur, becoming weaker, but being practically inexhaustible. There is in this operation a constant transfer of electricity from the earth to the sole, by induction, from the sole to the cover, by connection, and from the cover back to the earth by contact; all resulting from the negative charge on the hard rubber, and the insulation of the cover while resting upon it

OUR New York correspondent refers in this issue to two important and highly interesting installations of the electric motor. The power is to be used for mining purposes in both cases. In one instance the contract calls for the delivery of 2,000 horse power, three miles from the primary source—a water power—on an island, and the circuit will cross an arm of the sea 4,000 feet wide. In the other instance a circuit of eighteen miles will be erected and power distributed at fourteen different points along the circuit.

Repeatedly the WESTERN ELECTRICIAN has called attention to the mining regions of the west as a most promising field for the electric motor. In many places the price of fuel is prohibitive, especially where the only method of transportation is on a burro's or mule's back up steep mountains. If the method were reversed and, Mahomet-mountain like, the ore were transported to power for crushing, again the cost would be prohibitive; but if power could be applied directly at the mine without too great cost, then the cost for transportation would lie in taking the net products of the ore crusher to market. In the mining districts it frequently happens that water power in abundance is found, but at too great a distance from the place where the application of power is desired to be utilizable. For instance, one miner had this problem; A mine that promised to yield ore of high grade but located on a mountain side six miles away from power; no method of transportation save on mules' backs, and with that method of transportation a cost of production that forbade development of the mine. The miner is now investigating the electric motor.

The two installations described are important in that they will bring the electric motor prominently before the mining interests of the country and show what achievements can be attained by the electrician, and they are important and interesting to electricians on account of the problems involved and the methods of solution adopted.

Practical Electrical Measurement.[1]

By J. Swinburne.

Alternating Current Dynamos.—An alternating current dynamo can not be very accurately tested by the writer's method described in connection with direct current machines, because there are losses of power that do not exist in direct current machines. The changes of value of the armature current produces losses by Foucault currents in the pole pieces, and perhaps in the armature hub also. If these losses are known to be small, the writer's method may be used. The machine to be tested and another like it, or giving a similar curve, are run at approximately the same speed, and are then coupled together through a resistance which is great enough to prevent danger if the machines do not run together properly. The belt is then thrown off the machine to be tested, so that it runs as a motor. If there is difficulty in getting the two machines to synchronise, a coil with a little iron core, or something with self-induction, may be put in circuit. Iron wire resistance may do.

The power taken to drive the machine is taken with a wattmeter. From this is subtracted the power spent on the armature resistance, which is got by multiplying the armature resistance by the virtual current. In a direct current motor running loose this loss is so small that it may generally be neglected. This is not necessarily the case with an alternating current machine.

Having thus found the stray power, the efficiency is obtained by dividing the output in watts by the sum of the output, stray power and loss by armature resistance at full load. The exciting power ought also to be included.

Dr. Hopkinson's method may be applied to alternating current machines. Two machines are coupled rigidly so that one opposes the other, and the field of the motor is weakened. The balance of power is supplied by a small direct current motor. The dynamo behaves very much as if it were working on closed circuit transformers. A wattmeter is used to measure the power transmitted by the dynamo. The stray power is divided between the two machines, as in the case of direct currents.

Captain Cardew's method can not be applied to three alternating current dynamos; but a direct current motor, whose efficiency is known, may be used to drive an alternating current dynamo. The alternating current dynamo may then be connected up and tested, doing its ordinary work.

It may be desirable to find the curve of electromotive force and current of a machine. These can be taken by an electrometer. A contact is fixed to the axle and touches a stationary contact. The stationary contact can be fixed at positions corresponding to different fractions of a period. This contact arrangement, described by Mouton, was used by Joubert, but he discarded the use of the electrometer because he found it difficult to make it work. He had two instantaneous contacts on the axle; it is difficult to see why one would not have done. By moving the adjustable contacts into different positions a series of readings can be taken, from which the actual curve can be plotted. A galvanometer must not be used instead of an electrometer.

The current curve can be taken in shunt to a known non-inductive resistance. The needle may then be charged by a multiplier or set of cells.

The curves from transformers can thus be taken also, and compared with the dynamo curves.

Professor Joubert preferred another arrangement. He coupled up a Poggendorff arrangement as if he was going to measure a direct current; but put the contact-maker in the galvanometer circuit. This is perhaps the most practical arrangement. Of course it can also be applied to taking current curves.

Professor E. Thomson has brought out a very ingenious instrument. A mirror is oscillated on one axis by a small core in a solenoid connected to one circuit, and on another, at right angles to it, by another core and coil. On looking at a bright spot reflected in the mirror, a line or closed curve is seen. In fact, curves like Lissajous' figures are formed. This instrument is, however, of doubtful accuracy. The cores must have some inertia, and their attraction, if made of soft iron, is not proportional to the instantaneous current. If soft iron is used in one and magnetized steel in the other, of course figures corresponding to the octave would be obtained with curves of sines. On such an instrument any two similar current curves of the same phase will give a straight line; and if the phases differ very slightly the curve will be too narrow for its components to be determined. In fact, unless one curve is known it is impossible to find the other.

The writer has designed an instrument for automatically drawing the curves, but as it has not been tried yet, its description may be postponed.

The speeds of alternating current machines can be taken by means of a pitch-pipe. An ordinary tuning-fork or pitch-reed will do if the user has an ear sufficiently cultivated to tell the pitch of a note which does not belong to the same scale. If not, a pitch-pipe may be graduated to read very exactly. It must be remembered that pitch-pipes and reeds have temperature errors. A reed expands and gets flatter when warmed; a flue pipe or whistle gets sharper when fed with hot air, such as the breath.

Motors.—The testing of alternating current motors might as well be deferred until there are some to test.

It seems generally to be assumed that the only difficulty with alternating current motors is to start them. It seems probable, however, that there will be very great difficulty in designing a motor which will work with reasonable efficiency and varying load. An alternating is a widely different thing from a direct current motor. Take the case of two similar machines driven by belts and coupled in parallel. Imagine first that they have no self-induction, so that the current at any instant is equal to the algebraical sum of the instantaneous electromotive forces divided by the sum of the armature resistances. Such machines will have no tendency to synchronise. If in phase the opposing electromotive forces would neutralise each other at every instant. If they got gradually out of phase an alternating current would be set up, and power would be spent on the armature resistances. The machines would contribute equally to this waste. As the machines differed further, the waste would increase until when they were half a period wrong they would both be short circuited completely.

But if the machines have self-induction, as soon as one machine is ahead of the other and waste begins, the current curve is retarded, and this makes the leading machine do the larger share of the work. The self-induction may be large enough to make the leading machine do most of the work and supply the trailing machine with more power than it wastes. The trailing machine is then a motor. Thus a dynamo and motor with no self induction would not synchronise in parallel; and it is questionable whether machines can be so designed as to electromotive force and current curves as to give a reasonable efficiency with a varying load.

A motor can be run on a series circuit, and will then be efficient at full load; at no load the current remaining the same, of course the loss by armature resistance is not reduced. The machine does not run away as a direct current motor does, it goes on at the same speed. If overloaded, it simply stops. Unfortunately, there is little chance of series systems coming into commercial use. The efficiency of a series motor can be taken, as in the case of a dynamo. The motor described in the Hopkinson test just mentioned behaves as if it were in a series circuit at full load. Such a test must not be used to get the efficiency on parallel circuits. A wattmeter will take the power given to a motor, and if at any instant the motor acts as a dynamo, the instrument will deduct the power, so that it reads only the power absorbed. A motor can be put to run a direct or alternating current dynamo of known efficiency.

Transformers.—The obvious way to test a transformer is to measure the power supplied by means of a wattmeter, and the power given out, and to divide one by the other. The chief difficulty lies in the high electromotive force of the primary circuit. This may be dealt with by Mr. Kennedy's method of using another transformer whose primary is connected to the high electromotive force and the secondary to the pressure coil of the wattmeter. The transformer used for this must have a closed iron circuit, and the secondary should supply very little current. The method is then accurate enough.

If the same wattmeter is used to measure both the secondary and primary powers, or at least, if the same pressure coil is used, the self-induction error cancels out. This is important, because a very small error in reading makes a large error in the loss of power. A good closed circuit transformer, with a rapidly alternating current, should give about 98 per cent., so that an error of one per cent. in reading may halve the apparent loss of power.

A good closed circuit transformer has not only a high efficiency, but, on resistance, the curves of electromotive force and current in the primary and secondary are almost exactly the same in form and phase. It may then be safe to multiply the virtual electromotive force and current to get the power. But transformers do not generally work on resistance, but on incandescent lamps, and perhaps on arc lamps. In testing the transformer on either of these the wattmeter is safest. If tested on resistance without a wattmeter, the wire must be arranged to have no self-induction, and, of course, iron must not be used. On resistance, a Cardew voltmeter and a current dynamometer might be used, but it is safer to adhere to the wattmeter.

A closed circuit transformer can also be tested with comparative accuracy by simply putting an alternating electromotive force on one circuit. Thus the secondary circuit can be connected to the secondary of another transformer, so that low electromotive forces are dealt with. The power absorbed is measured. It will, of course, be small. This is the stray power. If the output is known, the loss by resistance in the secondary is taken; the loss by resistance in the primary is then calculated, allowing enough additional virtual current to give the stray power when multiplied by the virtual electromotive force. The three losses are added together and make the total loss, from which the efficiency is determined.

In measuring open iron circuit transformers the wattmeter method is the simplest and best on both circuits. These need not be fully discussed, as they are practically obsolete. The product of the virtual e. m. f. and current must never be taken on the primary circuit.

Incandescent Lamps.—As already mentioned, incandescent lamps do not behave like simple resistance, and they do not behave like resistance and self-induction; in fact, they have a kind of way of behaving of their own. A thin carbon appears to follow the current or power spent, by rapidly heating and cooling. The instant of highest temperature is after that of maximum power. If the resistance remained constant, this rise and fall of temperature would not interfere with the curves of the currents and electromotive forces. If it alters in resistance, as it does if it is not exactly at its points of minimum resistance, the curves are interfered with.

In addition to this, carbon is a bad conductor of heat, so that a carbon is generally hotter in the center than outside. This alters the current distribution to some extent.

The effect of flickering on a lamp is to make it give a higher candle power with an alternating current when taking the same electrical power as with a direct current. This is because the efficiency increases more rapidly than the power, so that when very bright the candlepower is much greater than the normal, and when dull it is not much less. As the breaking is most likely determined by the highest temperatures, not by the mean temperature, the lamp to last long must be run duller, till its maximum brightness is only equal to the normal brightness with a direct current. The mean light is then less than before, and the power taken is decreased, though not so much, so that on an alternating current a lamp should really be run to give less light than on a direct current, and at a lower efficiency, though with the same power it would have given more light. In practice, a lamp may be tested on the photometer to give about its normal light, and then run under similar conditions. At first sight it might appear that a Cardew voltmeter would flicker and would therefore have the same sort

[1] London *Electrical Review*, December 30th

of variation as a lamp. But the flickering tends to make a Cardew instrument read lower, not higher, so on this account it is less suitable. The flickering effect is probably very small, however, especially with a thick wire and rapid alternations.

Arc Lamps.—With direct currents arc lamps are treated as if they had a back electromotive force and a resistance. This is a convenient way of looking at it for direct current work, but it is much more likely that the resistance varies, and that there is no appreciaable back e. m. f. If the cross-section of the conducting heated air varies as the current, the resistance varies inversely as the current, and there would be an apparent back electromotive force. If this or something like it takes place, the arc would behave in much the same way on an alternating current. The virtual electromotive force might be kept nearly constant and the virtual current might vary, just as the electromotive force and current vary in direct current work. But if the arc has time to cool and increase in resistance between each alternation, the question becomes much more complicated. Most likely it cools too little to make very much difference. The writer does not know of any experiments on these points. The question might be very easily settled.

Electric Osmose and Electro-Capillary Action.[1]

Assuming with Clausius that in a case of electrolysis taking place in a liquid between, say platinum electrodes, a polaric bias is put upon the otherwise chaotic evolutions of the molecules of the electrolyte, by the e. m. f. of the current, it seems not unlikely that if the + and — ions be of unequal mass and the forces urging them in contrary directions be equal, more work will be done upon the lighter radicles than upon the heavier ones at each semi-revolution of the molecules of the Grotthus chains—for each liberation of ions at the electrode surfaces—owing to the difference of inertia; and that the liquid will in consequence be urged towards that electrode towards which the lighter radicle is moving; also, that if a friction be introduced by placing a porous diaphragm or a series of porous diaphragms across the liquid, the back flow of the liquid within the pores will be retarded, and a difference of level on the two sides of each septum limited only by the strength of the current and the efficiency and thickness of the septum will be produced.

I have been led to think that this action may account for the phenomena of electric osmose and allied effects by the following considerations:

1. Electric osmose is most marked in electrolytes whose molecules are of great relative unwieldiness and disparity of weight between their + and — components, as in the case of organic compounds.

2. The ion moving toward the cathode—H in the majority of cases—is generally the lighter of the two ions, which accords with the rise of liquid around the cathode in general. In cases which would seem to contradict this hypothesis it may be that the elements visibly liberated at the anode are not the only ones which accompany the — ions on their journey and add to their inertia.

3. That by reason of more work being done on the + ions than on the others the cathode is more strongly bombarded than is the anode by the elements liberated against it, so that if either electrode be varnished on one face and floated, or made with vanes like Crooke's radiometer, or hung in the liquid, pendulum fashion, it will move to or fro with different force to the other in like circumstances, as in the capillary electrometer of Dewar.

4. That the facts are not less consistent with the rather-more-difficult-to-grasp view that the active molecules of the Grotthus chains, in performing their semi-revolutions from the positions in which they are formed at every change of partners, following the liberation of each pair of complemental ions at the ends of the chains, swing round their centers of mass; and even if their centers of bulk be coincident with their centers of mass it may be that the friction they exert against contiguous molecules in turning "right about face" is greater or less for one direction of reversal than for the other, owing to the different nature of the two halves of each molecule. Wherefore the whole of the active molecules are impelled one way, and all the inactive molecules the other, with equal momentum but not necessarily equal volumes.

5. That if the centers of bulk of the active molecules be displaced, their friction against neighboring molecules will, by their being disseminated in infinite number throughout the liquid, urge it as a whole in one direction just as a net of fine mesh would do.

6. The apparent disagreement between this hypothesis and the fact that—at least, when the electrodes are fixed—the + and — ions each undergo equal displacement in opposite directions, as evidenced by their being given off in equivalent quantities, at the electrodes, will be seen to be only apparent when it is remembered that every time a + and — element is liberated at the ends of the Grotthus chains, those chains are left one molecule too short, and that there is an abundance of molecules ready to fall into file all along the line, so that more will therefore fall in at that end from which the active molecules tend to be displaced.

[1] A communication by R. Snowden to the Electrolysis committee of the British association, Manchester, 1887.

A Government Telegraph.

A correspondent in the Chicago *Journal*, signing himself "Telegrapher," writes as follows in regard to this subject:

"England, France, Germany, Russia and Italy have government telegraphs, partly because the centralization of power is in harmony with their forms of government, but principally because of the surveillance over all telegrams that the system gives government officials. England, the last great power to adopt it, did so as a military necessity, the frequent changes in European maps demanding equal facilities with other nations. European powers now have about an equal censorship over all press dispatches and the absolute control of all telegraphs. While the receipts and expenses of their telegraphs are usually included with those of the postal departments, the telegraph itself is as much, or more, a part of the military service as of the postal. Italy alone shows the telegraph self-supporting. With 11,250 miles of wire and 3,075 offices, it reports a profit last year of $248,465. The other powers, without exception, show large deficits, or else their telegraph accounts are not separated from those of the post offices, which in all cases show deficits. The very arguments that favor government telegraphs in Europe are the strongest in opposing it in this country, as the time for government censorship of the press, or any general centralization of power has not yet arrived. Business men who use the telegraph most are opposed to government telegraphs, and the only class or party advocating it are the Knights of Labor, who use it but little or not at all.

"The transparency of Powderly's claim that Mr. Gould controls the American press dispatches is readily shown. An executive order of the Western Union Telegraph company, dated long previous to Mr. Gould's acquiring any interest in the company, and still in full force, forbids its employes acting as agents for any newspaper or press association. The bulk of associated press dispatches are written and transmitted late at night, in many cases over leased wires, by a dozen or more rival news associations, employing their own operators, and their rivalry is so keen that the slightest attempt to suppress or alter any item of news would not only be unsuccessful but disastrous to those attempting it. As for any individual or set of individuals, having a secret espionage over private telegrams passing over the Western Union wires, when one considers that there are over 150,000 different telegrams transmitted daily from all points to all points, the absurdity of its being done or even attempted, without some employe with an alleged grievance, or some discharged clerk, being more than glad to make it public, is apparent. It is singular that no necessity for government telegraphy in this country, or that any of the specific advantages of such system over the present, has yet been shown."

After considering different features of the Cullom bill, the correspondent takes up the clause providing for "iron poles 'of size and strength required to properly support twelve wires,' for copper wires 'of the proper size and gauge to insure the best possible results,' with eight wires between New York and Chicago and four wires upon all other routes. The aggregate of routes covers 9,871 miles of poles and 44,016 miles of wire."

The writer proceeds: "The following figures, except for iron poles, show precisely what it would cost the Western Union Telegraph company to construct Senator Cullom's lines, and it is safe to say that the government would pay at least as much. Iron poles have never been used in this country; their price, therefore, is not easily obtained. For twelve wire lines, they would not be less than thirty feet long. The city of Chicago has lately erected at its bridges for river lighting, iron poles, fourteen feet high, to support one electric lamp, at a cost of $11 each. It is believed that iron telegraph poles of the necessary size and strength would cost not less than $15 each. We have then 325,743 poles (33 to mile), at $15, $4,886,145; 977,229 cross arms, at 20 cents, $195,445.80; 1,954,450 bolts and washers, at 1½ cents, $29,316.87; 3,908,916 pins, at 1½ cents, $58,633.74; 2,000 pounds 6-penny nails, at 3 cents, $60; 10,000 corner pins, at 5 cents, $500; 1,452,528 D. P. glasses, at 4 cents, $58,101.12; 44,016 miles 11-pound copper wire, 9,243,360 pounds, at 13¾ cents, $1,270,962; 90,000 pounds copper ties, at 16 cents, $14,400; 11,000 pounds solder, at 12½ cents, $1,375; 80,000 copper sleeves, at 2 cents, $1,600. Material, $6,516,539.53; add labor, $100 per mile, $987,100. Total cost, $7,503,639 53.

"Not included in the foregoing are freight and distribution of 1,200 car-loads of material, rights of way, not less than $4 per mile per annum, detours of lines for river crossings, submarine cables, extensions of lines from depots to post offices, instruments, main and local batteries, office fittings, stationery and miscellaneous, which will bring the total cost to at least $10,000,000.

"If it costs the government $10,000,000 to construct and equip for use 44,016 miles of wire, to duplicate the Western Union's wireage, which is 524,641 miles, would cost $119,193,247.91, and as the Western Union's capital is only about $85,000,000, this does not indicate the water to be as deep as is popularly claimed.

"One of the Western Union's construction rules is to put a lightning-rod, a piece of ordinary telegraph wire extending from top of pole to bottom, upon every tenth pole as a protection from lightning. In localities where lightning is unusually destructive, these rods were formerly in some cases placed upon nearly every pole, but, it being found impossible in fogs or damp snow to work wires over fifty to seventy-five miles, the extra rods were removed. If the effect of such rods was so disastrous, what might we expect if iron poles were used."

An Electrical Matrix Making Machine.

A new type setting machine, or rather a machine to avoid type setting, which promises to be of some importance, was recently designed in the office of *Wood and Iron*. The machine can not be said to be a type setting machine, because it does not set any type, but uses dies to produce a matrix direct, from which stereotypes may be cast. In the center of the machine is a die plate about three inches in diameter, which carries ninety-one dies, comprising all the characters that would be used in the body of any printed article. This die plate stands on short legs and slides on a steel plate about six inches square. This steel plate has a small hole in its center, through which the dies are driven to the matrix below. The die plate is attached to a thin lever about seven inches long, on the outer edge of which is a hard rubber button about the size and shape of the button on a telephonic instrument. The lever is pivoted about the middle of its length on a slide moving in and out from the center of the machine. By means of this swinging and sliding motion, a person taking hold of the button at the outer end may throw any part of the die plate over the hole in the steel plate below. At the outer end of the lever, just below

the button, is a metallic point which just slides over a hard rubber plate with holes arranged to exactly correspond with the arrangement of the dies in the die plate. By bringing the button, or key, over and pressing it down into one of these holes, the corresponding die is brought directly over thehole in the steel plate. The act of pressing the key down makes an electrical connection, which, by means of magnets at the back, throws the matrix the proper distance for the letter to be printed, and at the same time throws down a hammer, electrically, upon the die, driving it through the hole into the matrix. The operator's attention is confined strictly to pressing the key into the proper hole and throwing the spaces. This last operation is performed by dropping the key into a dummy hole, which throws the matrix without moving any die. When the end of the line is reached, a touch upon another key returns the matrix to the beginning of the line, when a touch upon a third key moves the matrix for either an ordinary or leaded line, as desired.

Justification is also ingeniously provided for so that all lines terminate exactly alike.

Experiments show a probable average speed of thirty words a minute, though it is expected that experts by practice will be able to considerably exceed this. The whole machine is considerably less in size than the ordinary type writer, so that it can be easily used on any desk, or transported from one place to another.

Note on the Theory of the Electrophorus.[1]

By E. C. Rimington.

In most elementary text books the theory of the electrophorus is explained in a manner somewhat similar to the following: The ebonite on being excited by beating with a catskin takes a certain negative charge, often known as the "inductive charge." On placing on it the brass cover there is induced on the side of the latter next to the ebonite a positive charge nearly equal to the negative charge on the ebonite. This is known as the "induced or bound charge." On the other side of the cover an equal positive charge is induced, called the "inductious or free charge." On connecting the brass cover to earth or to the brass plate fixed to the bottom of the ebonite, the sole, the latter charge is neutralized by the positive charge which was given to the catskin, leaving the induced positive charge on the cover in the form of a free charge.

This explanation can not be said to be correct under the conditions which usually exist when the instrument is worked. The surface of the ebonite is beaten with the catskin, the latter being in connection by means of the hands and body of the operator with the sole. A certain — charge is produced on the ebonite and an equal + charge on the catskin; this latter will distribute itself over surrounding objects, including the sole, inversely as the resistance to induction. Now, the inductive resistance between the top surface of the ebonite and the sole is generally much less than that between the ebonite and other objects, such as the walls of the room, etc., since it is only the resistance offered by a comparatively thin layer of ebonite. Hence nearly all the + charge will be situated on the sole. We may picture to ourselves the lines of force which pass through the dielectric from the + to the — charge, as nearly all passing through the ebonite and only a few through the air. The cover is now put on; this will not practically alter the inductive resistances; so that the number of lines of force which cut the cover is very small compared with the total number, hence the induced, and consequently the inductious, charge on the cover is very small compared with the charge on the ebonite, not as generally stated, nearly equal to it. The inductive resistance between the cover and the ebonite is caused by a very thin film of air and is very small compared with that between the sole and the surface of the ebonite, so that when the sole and the cover are connected together nearly all the charge in the former distributes itself over the cover, so that the charge on the latter is now nearly equal to that on the ebonite. We have in fact a condenser, of which the cover and the sole form the + coating and the top surface of the ebonite the — coating, all the lines of force starting from the former and terminating in the latter. The cover of course no longer possesses induced charges since no lines of force now cut it. On removing the cover an electric field is set up between it and the ebonite and in discharging it by touching any object in connection with the sole, the charge on it is again distributed over the sole.

Estimating the charge on the ebonite as 100, the corresponding + charge is consequently 100, of which 99 is supposed to be the charge on the sole and one that on surrounding objects. The sole is in connection with the walls of the room, the lines of force nearly all pass between the ebonite and the sole, and only one per cent. between the ebonite and the walls, these latter cutting the cover. When the cover and sole are connected 98 per cent., suppose, of the charge is distributed over the cover. Let the cover be raised from the ebonite; there are now two inductive circuits, one through the air, from the cover to the ebonite, and the other through air from the cover to the walls and from them to the sole conductively, then through the ebonite from sole to ebonite. As the cover approaches the walls its inductive influence on them increases while that on the ebonite decreases, and when it finally touches the walls or some exterior object and is discharged, the conditions existing before it was placed on the ebonite, after the original charge to the ebonite was given, are restored.

The fact of the induced charge on the cover of the electrophorus being much smaller than the free charge it possesses when removed can be easily shown experimentally by the aid of a gold leaf electroscope. Excite the ebonite in the usual way, and place it on the top of the electroscope, inverting the electrophorus; the brass plate of the electroscope now forms the cover of the electrophorus, a slight divergence of the gold leaves will take place, due to the inductious discharge. Now connect the sole and cover and the leaves will at once collapse. On breaking the connection and removing the ebonite from the electroscope they will again diverge to a much greater extent than before, this divergnce being due to the free charge on the electroscope plate acting as the cover.

[1] Abstract of a Paper in the London *Electrical Review* January 6th.

Cost of Lighting some Ohio Towns.

Recently the city council of Mt. Vernon O., sent out a circular letter to gain information on the electric light question, and propounded the following questions :

1. Does your city or a private company operate the plant? 2. If the former, what system is in use, and what was the total cost of plant? 3. How many arc lamps are used to light your city, and what is the cost per year of each arc light."

Nine cities out of eleven were heard from, and the information derived may be summarized as follows :

Alliance, O.,—by private company; Western Electric company's system; one street lighted with 8 arc lamps, at $12 per light per month, and burn all night.

Defiance, O.,—by private company; Western Electric company's system; 52 arc lamps at $60 per year per lamp.

East Liverpool, O.,—by private company; Western Electric company's system; cost of plant, about $15,000; 32 arc lamps in use; first 25 lamps at $85 per year, balance at $80 per year. Light gives good satisfaction. Lamps are swung at intersections of streets, and outside of business portion we alternate at each intersecting street, using the cable system.

Mansfield, O.,—by private company; Western Electric company's system; 70 arc lamps in use, at $75 per lamp per year. More have been added since this report.

Massillon, O.,—by private company; Schuyler Electric Light company's system; 80 lamps 2,000 candle power, $70 per year per lamp. Citizens think it the finest lighted city in Ohio.

Norwalk, O.,—by private company; Western Electric company's system; 82 arc lamps used, at $70 per lamp per year.

Painesville, O.,—by private company; Western Electric company's system; 55 arc lamps used, at $72 each per year. The lights give general satisfaction, and are a great improvement over lighting by gas, with very little, if any, additional expense.

Steubenville, O.,—by private company; we have about 150 incandescent lamps around the suburbs, each 25 candle power, for which we pay $20 per year for each lamp.

Sandusky, O.,—by private company; Brush and Western Electric companies' systems; 125 arc lamps of 2,000 candle power each; we pay $82 for each arc light per year; contract extends for one year.

At Portsmouth, O., with a population of 13,000 and an extensive territory, the city owns a Thomson-Houston plant which cost $18,000. There are 93 lamps of 1,200 candle power each in use, each lamp costing about $38 per year. The city does not use either gas or oil for street lighting purposes, but burns the electric light whenever necessary, early and late as the occasion may require. The citizens claim that Portsmouth is the best and cheapest illuminated city of its size in the state.

Lamp Lighting Schedule—Moonlight System.

Appended is a lamp-lighting schedule—moonlight system—for the month of February, 1888, applicable in Illinois, Indiana, Ohio, Iowa, Nebraska, Pennsylvania, New York, New Jersey, Rhode Island, Connecticut, and practically in Kansas, Missouri, Colorado, Wyoming, Kentucky, Maryland, Delaware, Virginia and West Virginia.

The time for commencing to light is calculated at one half hour after sunset or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock, midnight, is shown by bold face type; after midnight by light face type.

February.

Day of Month.	Light.	Extinguish.	Number of Hours
	H. M.	H. M.	H. M.
1	**5.50**	**10.40**	4.50
2	**5.50**	**11.50**	6 00
3	**5.50**	1 00	7.10
4	**5.50**	2.10	8 20
5	**5.50**	3.20	9.30
6	**5.50**	4.20	10.30
7	**5.50**	5 20	11.30
8	**6 00**	6.00	12.00
9	**6.00**	6.00	12.00
10	**6.00**	6.00	12 00
11	**6.00**	6.00	12.00
12	**6.00**	6 00	12.00
13	**6.20**	5.50	11 30
14	**7.20**	5 50	10.30
15	**8.20**	5.50	9.30
16	**9.20**	5.50	8.30
17	**10.10**	5 50	7.40
18	**11.10**	5.50	6.40
19	12.10	5.50	5.40
20	1 00	5.50	4 50
21	2 00	5 40	3.40
22	2.50	5.40	2.50
23	3.40	5.40	2.00
24	4 10	5.40	1.10
25	No	light	0.00
26	"	"	0.00
27	"	"	0.00
28	**6.20**	**8.20**	2.00
29	**6.20**	**9.40**	3.20
	Total number of hours,		197.40

An Electric Chess Recorder.

We had last week an opportunity of inspecting, at the offices of Messrs. Woodhouse & Rawson, of Queen Victoria street, London, a new apparatus, devised by Dr. Wurstenberger, of Zürich, for automatically recording a game of chess as it is being played, says *Industries*. The record is printed on a tape in the usual way, that is to say, by reference figures and numbers. As customary, the position on the board is defined by two co-ordinates, one referring to the distance from the left hand corner to the right, and the other to the distance across the board, the former being given by a letter, and the latter by a number. In printing the record, the number is printed immediately below the corresponding letter for the white pieces, and with an intervening space below the letter for the black pieces. The pieces are provided with plugs which fit corresponding

holes in the board, the plugs of the white pieces being of wood, and those of the black pieces of metal. The record is transmitted from the board to the printing apparatus by means of electricity, there being sixty-four separate wires joined into a cable. Each black piece, when being taken up or put down, completes by its metal plug a circuit which actuates an electromagnet. The armature of this magnet is then attracted, and displaces the spindle of the type wheel carrying the numbers longitudinally, and thus provides the wider spacing between the letters and numbers for the black moves. When the white pieces are inserted or withdrawn, no current is sent into this magnet, and the type wheel carrying the numbers remains close to and side by side with that carrying the letters. The plugs at the bottom of the chessmen have, however, also another function to perform. In being withdrawn or pushed in they deflect contact springs, and by this means a current is sent along that particular wire which corresponds to the square on the board from which a piece is taken up or on which a piece is set down. These wires terminate at the printing apparatus in forty-six segments arranged in two disks, thirty-two in each, and round each disk revolves a small brush, the motive power being derived from a spring, very much in the fashion of an ordinary Morse receiver, and the paper strip is at the same time advanced. As soon as the revolving brush comes opposite the segment connected to the wire corresponding to the position on the board which is to be recorded, the circuit through this wire and through another electro-magnet is completed, by this means raising a roller and pressing the tape against the type wheels, as in all printing instruments. From our description it will be seen that the pieces must be taken up and set down slowly, so as to give the brush time to revolve until it meets the particular segment from which the current is sent to the electro-magnet; but the inventor, in order to obviate this difficulty, has introduced a relay between the board and the printing instrument, so that the pieces may be taken up or set down as fast as may be desired. On our visit, however, we did not see this relay in action, it having been damaged during transit. Dr. Wurstenberger's chess recorder is a very ingenious piece of delicate electrical machinery, but it has evidently only a limited field of application. It would principally be useful in clubs, where it may be desired to record in one room the game being played in another; but as there are sixty-four circuits, it could not be employed for telegraphing the game to any distance.

CORRESPONDENCE.

New York Notes.

New York, Jan. 28.—The annual report of Superintendent McCormick, of the Bureau of Lamps and Gas, shows that the cost of lighting New York city in 1887 was nearly seven hundred thousand dollars. During the year there were used 25,471 street, market and park lights, including 820 electric lights; 120 new electric lights and 525 new gas lights were established. The prices charged the city by electric lighting companies for street lights range from 19.9 cents to 40 cents per night.

In Brooklyn over a thousand electric lights were in use in the streets last year, and it is evident that the city authorities intend to extend the system, as they have appropriated $480,000 for street lighting purposes in 1888, as against $360,000 in 1887. The price paid in Brooklyn to the two electric lighting companies who control the business, the Citizens' and the Municipal, is fifty cents per light per night.

Senator Coggeshall has introduced at Albany a bill for the appointment of a commission to supervise the electric lighting companies in New York state. He proposes to have three commissioners appointed for a term of five years, at a yearly salary of $7,500 for each, these commissioners to exercise powers over the electric lighting companies similar to those which the railroad commissioners have over the railroads.

William Q. Judge has been appointed receiver of the Excelsior Electric company, of 9 Dey street, New York, and 216 Willoughby street, Brooklyn, by Judge Andrews, of the supreme court.

It is generally believed by electric motor people that the motor system is to find its greatest usefulness in long distance transmission of power. Mining property of enormous value throughout the west has been lying idle for years, only on account of the lack of power for its development; but now the electric motor system comes forward and proposes to supply power in almost any situation at a reasonable expense. We mention this because we learn that the Sprague company have recently closed two contracts for the transmission of power in mining districts in California, other power being unavailable. In one case 2,000 horse power is to be carried 4,000 feet under an arm of the sea to an island, and delivered three miles from the primary source of the water power. The other contract referred to is for the delivery of large units of power at mines over a circuit of 18 miles, the power to be distributed at 14 different points on the line. These two equipments will place the achievements of the Sprague system far ahead of anything that has been hitherto either attempted or accomplished.

The East Orange township committee has finally decided not to grant a franchise to any electric lighting company which will not contract to put its wires underground. An application for a franchise was made some time ago by the Edison company, but thus far it has failed to to obtain one.

The Electric Gas Lighting company, of Boston, have published a new illustrated catalogue dated January, 1888. In addition to cuts and descriptions of electrical apparatus of all kinds, the catalogue contains full and plain directions for wiring houses and gas fixtures, setting up batteries, etc. A.

From St. Louis, Mo.

St. Louis, Mo., Jan. 28.—The rate charged for telephones in this city is $100 per year. A number of subscribers regarding the price too high, have appealed to the house of delegates to pass an ordinance reducing the rate to $50 per telephone per year.

The telephone exchange made some interesting experiments recently to determine the variations in five-minute periods of ten hours' traffic from eighty-nine stations served by one operator. The diagram of fluctuations, drawn to show how business with the 'phones ran from 8 a.m. to 6 p. m., was quite irregular, and had one tall pinnacle located at 11:40 a. m., this abnormally high point indicating the result of an attempt to force upon the operator the greatest possible number of connections in five minutes. The point was up to fifty-three connections. The average number of connections, per result of the experiment, were per minute, 1.94; per five minutes 9.72; per hour, 116 7.

General manager Durant, in an interview, gave some interesting figures in regard to the work of the exchange: "The average daily work of the exchange from 7 a.m. to 7 p.m., under ordinary circumstances, from Mondays to Fridays inclusive, is 15,500 connections per day, bringing into use 31,000 stations. On Saturdays the average is 16,000 connections; Sundays 1,900, and holidays 4,600 connections. From 7 p.m. to 7 a.m., the average is 550 connections. The busiest hour in the day is from 9 a.m. to 10 a.m., when we handle about 1,900 connections." C.

Detroit's Budge .

Detroit, Jan. 28. — The St. Clair & Sanilac Telephone company, operating in the counties of Sanilac, Huron, and St. Clair, not caring to defend the suit filed against it by the American Bell Telephone company, has thrown out the Cushman instruments and transferred its line to the Michigan Bell Telephone company. The people along the line of route are pleased with the transfer, as it affords them the increased facilities of the Bell company, and assures efficient service—something the defunct company could not provide.

Some time ago, Joseph Weiden, an employe of the Brush company sued for damages, the result of a fall of seventy feet in a tower elevator, caused by a defective cable. The specific defects were not set forth in his declaration. Judge Hosmer before whom the case came a few days ago, sustained a demurrer in which this omission was set forth.

J. H. McLaughlin who, since organizing the Edison Illuminating company in this city two years ago, has been its manager, will leave for New York February 1st, to take a position with parent company. Mr. McLaughlin will devote his entire time to the organization of central stations similar to the one so successfully operated in Detroit. C. P. Gilbert, one of the directors, will probably succeed to the local management, having been tendered the position at the last meeting of the board of directors. C.

A Providence Enterprise.

Providence, R. I., Jan. 27.—The Armington & Sims Engine company purchased, in July last, the Paine & Sackett mill on Eagle street, for a sum less than $100,000, and have removed their stock and machinery from their works, 546 High street to the former location. The Armington & Sims Engine company came to this city from Lawrence, Mass., in 1882, established their works on High street, and have gained a world wide reputation for their electric light engines. The distinctive qualities of their engines are high speed and perfect regulation. Since the establishment of this company here, the business has increased to such proportions that now the Armington & Sims engine can be found in almost every city in this country and in many cities abroad.

Some time ago it was seen that the High street establishment was inadequate for the increasing business, and the company determined to purchase the Paine & Sackett mill, with additional buildings covering nearly two acres of ground, which was offered for sale at very attractive figures. During the past year more orders have been received than could be filled, even while restricting the supply to engines for electric lighting purposes. The recently purchased property on Eagle street is very well adapted to the needs of the engine company. They are now erecting monitor roofed sheds near the main building, which will enable the company to branch out their business.

They have recently purchased over $20,000 worth of new machinery from the best manufacturers in the country, and it is needless to add that the new machines are largely automatic and of the very latest pattern. They now have a large number of orders on hand, among them one aggregating $80,000 for engines for the Edison Electric company, of New York; another for four 200 horse power engines for the Edison Central station at Chicago, Ill., and a 250 horse power engine for the Tunis Lumber company, of Norfolk, Va. Their works will soon be in full operation, when they will employ between three and four hundred men. P.

THE ELECTRIC LIGHT.

The New York *World*, in describing its large and extensive equipment, says that in fifty minutes from the time a drawing is received the block for printing is in hand in the composing room. The paper owns a complete photo engraving plant. Two cameras, with the most expensive lenses, and each capable of making plates 11 by 14 inches in size, are mounted in the most perfect manner so as to give all possible range of adjustment of focus and distance from the object to be photographed, with both vertical and horizontal adjustment for the latter. Two powerful electric arc lights, of six thousand candle power each, render the operators independent of daylight. To save time, several pictures are made upon one 11 by 14 inch negative. The negative taken by either one of these cameras is at once "stripped," and the gelatine remounted on glass so as to make a reversed negative. From this there is taken a reverse print, by electric light upon metal. This is suitably manipulated by a secret process, and at once put into the bath, from which it emerges engraved in perfect fac-simile of the ordinary drawing, and all ready for routing and blocking.

At a recent juvenile lecture given by H. W. Preece, at the Society of Arts, in London, an arc lamp was shown in action, by means of alternating currents, supplied from a central lighting station. A Brockie-Pell lamp, specially wound for

alternating currents, was used. The current was conducted to the lecture room by overhead wires, insulated on fluid insulators, from the Grosvenor Gallery station, fully a mile away.

The Thomson-Houston company will light the Theater Moliere, in Brussels.

The Lima, O., city council at its meeting January 24th, voted to contract with the Electric Light & Power company to light the city with the electric light for a period of one year.

The gas and electric light combination is making satisfactory progress in New England. One of the most recent converts to this system of mixed lighting is the Pawtucket Gas company, of Pawtucket, R. I., the general manager of which, Mr. Stiness, is laying out to do a large amount of electric lighting in connection with his gas industry. He is building one of the finest stations in New England and has adopted the American system, which is now being installed.

The city of Lewiston, Maine, some months ago decided to do its own street lighting. Ten different companies competed for the contract to furnish electrical apparatus for the purpose. The award was finally granted the American company. The plant has just been completed, and the mayor reports that it is giving perfect satisfaction.

The Paris municipal council has passed a resolution authorizing the expenditure during the current year of one million francs for the establishment of a municipal central lighting station to supply electricity for lighting the Hotel de Ville and the surrounding district.

The Paris, France, city council has decreed that electric light wires must go underground.

The Helena, Ark., Electric Light & Power company has been organized with a capital stock of $25,000. The officers are: Jas.Summers, president; Leon Berton vice president ; J. C. Barlow, treasurer, and Jacob Trieber, secretary. The directory consists of Jas. Summers, Leon Berton, J. C. Barlow, Jacob Trieber, J. H. Andrews, F. B. Sliger, C. A. Walterhouse and B. R. Fitzpatrick. It is expected that the company will be ready for business in sixty days.

The Silvey Electric company of Lima, O., are to fit a locomotive of the Cincinnati Southern railroad company with an electric headlight. The engine which furnishes the power for the light is very small and placed on the running board of the locomotive. It occupies but little space and is furnished with steam from the locomotive boiler. The carbons for this light are held firmly against any jar and are fed automatically, thus insuring a steady light.

The Kingman, Kan., *News* says a mule drank out of the mill race which supplies the power for the electric light plant in that town and the lights went out for five hours.

The American Electric Light company of Kansas City, Mo., has been incorporated. The capital stock is $25,000, divided into 250 shares of the par value of $100 each. The stockholders are M. S. Porter, O. W. Ditsch and H. M. Porter.

The McPherson, Kan., Electric Light company has ordered an extra boiler.

A Council Grove, Kan., correspondent writes, under date of the 18th ult.: "The Thomson-Houston electric light system was put into operation this evening. Main street for a distance of one mile is brilliantly illuminated by arc lights, placed at each street crossing. The principal stores and offices also have the lights. The power is furnished by the Council Grove Water Works company, the fifty arc light dynamo and engine of the electric system being located in the engine house of the water works pumping station. A 150 incandescent light dynamo will soon be added to the station."

Recently at Elgin, Ill., the high school and academy faculty and the pupils who were interested in the study of natural philosophy were invited by George S. Bowen to the Elgin electric light station to study the principles underlying the electric light. J. H. Risdon, the engineer, received his guests most courteously and added much to the pleasure and profit of the visit.

THE ELECTRIC MOTOR.

A new system of cash railway for stores is a cable line operated by an electric motor. The grooves in which the boxes move are of nickel plate. At each corner are wheels, around which the cables are arranged, a lower and an upper one. The lines go all over a store, and could be carried into the attic or very far away with the necessity of only one headquarters. The boxes, little nickel plated square ones, shut with a spring and fitted with clutches, are side-tracked at the station by grooves. The clerk puts the money and check inside and slides it on to the main groove, when quick as a flash it is taken by the cable and hurried up inclines and around corners with wonderful rapidity. In a second or two it returns at the same fast rate. Compared with the rolling ball system it is like the locomotive to stage coach, or electricity to steam.

THE TELEPHONE.

In the circuit court at Rochester, N. Y., on the 22nd ult., Justice Rumsey directed a verdict for the plaintiff for $66.87 in the case of the Bell Telephone company, of Buffalo, against George H. Worrall & Co., the suit brought to test the right of the company to collect the rent due on contracts in existence at the time the telephone strike was inaugurated. In deciding the case the court said that the form of contract between the telephone company and its subscribers was decidedly one-sided, affording no guarantee to the latter that the value of the service would not be diminished or that the business would be continued at all beyond the expiration of the contracts. There was no evidence to show that the change from the flat rate to the toll system or that the prices under the toll plan were exorbitant or unreasonable. The only restriction in the most extreme view of the case that could be imposed on the company was, that it could not willfully make such rates and conditions as would cause the public to be excluded from the right to use the system. Such an act must be of a willful character, and for the purpose of exclusion. If the company raised the rates, and if it were a mere error of judgment as to the best means of conducting business, that would be a mere mistake and would not constitute a willful act which could be restricted. The court denied the request of the defendants' counsel to submit certain questions to the jury, but suspended entry of judgment and ordered that the case be heard at the general term as in the first instance.

The telephone exchange at Paducah, Ky., now has 90 subscribers with more orders to fill. N. F. Harman is in charge and has been for three years.

As an illustration of the magnitude of the telephone business abroad it is worthy of mention that the Bell Telephone Manufacturing company, of Antwerp, Belgium, has purchased for use in the manufacture of telephone instruments and apparatus, a ship load of walnut logs. These logs have been shipped recently from Newport News to Antwerp, and they make the third shipment of walnut logs within three years, all to the same company, the manager of which, F. R. Welles, early saw the economy of purchasing the logs in quantity where they grow and transporting them to Antwerp to be cut up there, as required, by cheap labor. This method, of course, would be practicable only where large quantities of the wood are used.

THE TELEGRAPH.

The Western Union office at Chattanooga, Tenn., was burned out on the 28th ult.

The Baltimore and Ohio District Telegraph company in Baltimore, Md., has been purchased by the American District Telegraph company. The two systems will be amalgamated.

A jury at Atchison, Kan., has awarded Joseph Jacobs a verdict of $2,000 damages against the Western Union Telegraph company for its failing to deliver a message promptly.

A force of telegraph linemen are pushing forward the new telegraph wire between Fort Dodge and Sioux City, Ia., at the rate of fifteen miles per day, when at work, although the intense cold weather which has been prevailing seriously interfered with the progress of the work.

The German post-office is this year expending some $1,875,000 additional for the telegraph and telephone services, of which the latter gets about $750,000. In Berlin and Hamburg the wires are going underground at a cost respectively of $375,000 and $125,000. Copper is now used on all new lines. Multiple trunks are to be erected between Cologne and Frankfort, Berlin and Dresden, Berlin and Frankfort, and Berlin and Cologne. These are estimated to cost about $205,000, while $25,000 is to be devoted to altering existing iron and steel lines to copper.

A press dispatch from Washington dated the 24th ult., runs: A sub-committee reported favorably to the house post-office committee Representative Anderson's bill relating to the telegraph lines of the Pacific railroad companies. The bill has been amended in some respects so that it now requires the subsidized railroad companies to maintain and operate their own telegraph lines and afford equal facilities to all telegraph companies in the reception and transmission of telegraphic business. The bill confers authority on the interstate commerce commission to enforce its provisions. Railroad officers or agents are made liable to a fine of $1,000, or imprisonment for six months, while the company is held liable for civil damages.

The United States supreme court at Washington, D. C., on the 30th ult., reversed the decision of the United States circuit court for the Iowa southern district in the case of the Western Union Telegraph company vs. George F. Hall. November 9, 1882, George F. Hall telegraphed from Des Moines, Iowa, to Charles T. Hall, at Oil City, Pa., an order to buy 10,000 barrels of petroleum, if thought safe. The telegram was not delivered until too late to execute the order. At the opening of the exchange on the following day the price of petroleum had advanced 18 cents a barrel. Hall contends that, by reason of the failure of the company to deliver his message promptly, he lost $1,800, the sum he would have made had his order to buy been duly executed, and had the oil so bought been sold at the advance of 18 cents on the following day. This court holds that the only theory on which the plaintiff could show actual damage or loss is on the supposition that if he had bought on November 9th, he might and would have sold on the 10th. It is clear, however, that in point of fact he has not suffered any actual loss. No transaction was in fact made. If the order had been promptly delivered and executed it is not found that Hall would have sold the next day at the advance nor that he could have resold at a profit at any subsequent day. The only damage for which he is entitled to receive is the cost of transmitting the delayed message. The judgment is reversed and the case remanded, with directions to enter a judgment for that sum merely.

The order of Railway Telegraphers of North America, Chicago division 42, gave their first reception, January 24th, at Martine's West Side Academy. All of the operators who were off duty, or could manage in any way to be relieved from work, were present, while many came from Aurora and Galesburg and other adjacent towns. The dancing commenced early and was kept up until a late hour, the floor being crowded nearly all the time. Some of the dances were as follows: "73 to All," " Dots and Dashes," "Our O. R. T. Girls," "To our Superintendent of Telegraph," " To Our Chief Train Despatcher," "To the Telegrapher," "Close Your Key," "Cut Out," and "Our Employers." The committee in charge were as follows: Arrangements—J. A. Bordeaux, C., B. & Q.; G. A. Sherman, Belt Line; W. A. Morrison, C., St. L. & P.; C. A. Walker, C. & N. W.; T. J. Costello, P., F. W. & C.; J. Sherer, C., St. L. & P.; E. Sovacool, C., St. L. & P. Reception—J. J. Gallagher, B. & O.; J. T. Downey, C. & W. I.; M. D. Ryan, C., R. I. & P.; S. G. Hutchinson, C., M. & St. P.; J. B. Haylow M. C.; Miss M. A. Karr, W. C., Miss M. C. Mead, I. C. Floor Committee—C. A. Sherman, Belt Line; J. Lindquist, C., A. & St. L.; S. H. Stark, C., St. L. & P.; H. C. Hasney, C. & G. T.; E. C. Demund, C. T. Company; E. R. Cole, C. & A; J. N. McMinn. C., A. & St. L. Among those present were: Messrs. and Mesdames Hartborn, Hattendorf, J. A. Bordeaux,

Sovacool, Fraser, C. A. Sherman, J. W. Creed, McGlinn, G. W. Bernard, A. C. Burke, Weston, the Misses Robinson, Brennan, Gorham, Nixon, Lowe, Mosier, Tulley, Laudfors, Dixon, Becker, Brues, Emmerick, Cusic, Kramer, Britt, Necker, Bruce, Shields, Taylor, Hofer, Robertson, Keefe, Nimmons, Murphy, Burke, Fox, Mrs. J. T. Downey, Mrs. W. B. Morrison, Mrs. K. E. Clough, and Messrs. Irwin, Share, Franzen, Tiffany, Frem, Kramer, Halley, Bruce, Huber, Brues, Wilson, Carrithers, Nieland, Knight, Preston, Walker, Kane, Ward, Hall, Donnelly, Weston, Jordan, Falvey, Dumond, Donovan, Watt, Kenny, Armstrong, Horn, Nell, Hull, Adams.

NEW ENTERPRISES.

The Honore building, corner of Dearborn and Adams streets, Chicago, is soon to be the scene of important changes. It has been sold on the basis of $800,000 to A. J. Cooper, of the Adams Express building, and to F. E. Hinckley, the millionaire railroader. The new purchasers intend to expend from $300,000 to $500,000 in alterations. The interior is to be entirely taken out, the first two stories are to be arranged for stores, and the upper floors, with two to four stories added, will be converted into a first-class hotel. The building is to be made absolutely fire-proof, and the upper fronts remodeled in modern handsome architecture.

A project to build another theater in Rochester, N. Y, has been started and capitalists are subscribing liberally. George Weldon appears to be the promoter of the enterprise.

Miscellaneous Notes.

A curious thing occurred last Thursday evening, when we had quite severe lightning, says the Orlando, Fla., *Record*. One of our surveyors was out in the woods surveying, and on the approach of the storm took shelter under a large tree, leaving his compass on the jack staff, some two or three hundred yards away. During the storm a tree very near the compass was struck by lightning, and, strange to relate, the effect upon the compass was to reverse it so as to make the north point of the needle change position and point south. The gentleman not knowing that fact, when he went back to the compass took a sight and started, as he supposed, for home. After walking eight or ten miles, going north, as the compass indicated, he, away in the night, came to the house of an old settler, who, upon inquiry, told him where he was and how far from Orlando, and the proper direction, which, of course, was exactly opposite to that indicated by the compass. After becoming satisfied something was wrong with the compass, and that the settler was right, he retraced his steps, and arrived at home tired, wet, and mad. This is the second instance we have known of the needle of a compass being affected by lightning so as to become reversed. We believe this, as we know the gentleman has not been to Kissimee lately, nor received anything by express from there.

In the issue of January 21st of the *Scientific American* is shown an illuminating apparatus designed by George M. Hopkins, as an auxiliary to bell buoys and whistling buoys on dangerous coasts. The apparatus is based upon the generation of electricity by the agitation of mercury in a high vacuum or in gas of high tension. The self-exciting Geissler tube involves the same principle. The buoy is adapted to ring a bell by the rolling motion imparted to it by the waves. Advantage is taken of this motion to agitate mercury in the annular tubes placed in the upper portion of the frame of the buoy. The tubes are made very heavy and strong, and each contains barriers for causing friction of the mercury against the sides of the tubes. To insure the action of one or more of the tubes at all times, they are inclined at different angles. A slight motion of the buoy causes the mercury to travel circularly in the tubes and generate sufficient electricity to render the tubes luminous.

A sad accident occurred at a new cable road in St. Paul, Minn., on the 27th inst., by which one person was killed and seventeen injured. The line, which by the way had been in operation only six days, runs over St. Anthony hill. At the foot of the hill there is a sharp descent and a sharp curve. A descending train became uncontrollable, and at the curve left the track, the cars rolling over and over in great confusion. The accident was caused by the grip being unable to grasp the cable, which was coated with frost and ice.

In Giles Bros. & Co's jewelry establishment in Chicago, is shown a handsome galvanometer, made by Forée Bain, of Chicago, for the United States government. It bears the somewhat comprehensive and imposing title of combined tangent, sine, cosecant differential galvanometer. The instrument measures current strengths to 1,000 amperes, electromotive forces to 3,000 volts, and resistances to 10,000,000 ohms.

A railroad velocipede is at present being experimented upon by the military authorities of France. It is a wagon of very light build and little weight, and has four wheels of thirty inches diameter, with rims constructed for running on rails. One man can move it at a speed of forty to fifty miles an hour it is said. By means of a brake it can be stopped in a distance of five yards, that is, almost instantaneously. It can be easily lifted off the rails by one man to get out of the way of a locomotive, for instance, and as easily replaced after the train has passed. By fixing gutta-percha rings around the wheels the velocipede can be prepared to run on country roads. The durability of these machines, as constructed by the French, is said to be marvelous. Such an engine, if practicable, might solve the problem of private conveyances running on railroads as on highways, especially if provided with storage batteries.

The purposes to which accumulators can be put are without end, and the more familiar they become to the public the more uses are found for them. For instance, Mrs. Thomas Dent, of 1823 Perry avenue, Chicago, gave a brilliant reception last week and as a feature of the occasion had a magnificent center-piece of flowers on the banquet table and the awning leading from the entrance to the mansion to the street curb illuminated by electric lights, the current for which was supplied by accumulators. The center-piece was particularly brilliant and beautiful and received its due share of attention and admiration. In all there were twenty-four 16 candle power lights, some three volts and others six volts. Johnson, Holland & Co., of Chicago, made the installation and were so successful that several other temporary installations of like nature have been ordered.

S. L. Barrett, an electrician, was sentenced to jail in Houston, Tex., for a period of twenty days for using a pistol in the County court house. While in jail he invented an instrument that he calls a micro-detecter. While in working position it will warn a jailer if prisoners are attempting to escape by sawing, filing, or using any other adroit means. It was tested by a number of citizens, they posting themselves in a front room in the back part of the prison, with doors closed. A clock was put in motion Every click could be distinctly heard in the room. A saw was used gently on the bars, and produced a loud sawing noise. The instrument is worked by electricity on a single wire, the various noises of the cells coming over it distinctly.

Personal Paragraphs.

Mrs. Ayrton, wife of the eminent electrician, Professor Ayrton, is about to institute a course of lectures to ladies in London on electricity. Mrs. Ayrton is a graduate of Girton college, Cambridge, a past student of the City and Guilds of London Technical college, Finsbury, is now a student in the department of electrical engineering at the Central institution, South Kensington, and is therefore particularly well fitted to undertake the mission.

Fred DeLand will represent the Electrical Supply company as traveling salesman in northwestern, western and southern territory. He is popular in Chicago, and doubtless will be as popular with the trade as he is at home.

T. C. Harnish, manager of the Sven Tideman Electric company of Grand Rapids, Mich., was a visitor at the Chicago Electric club rooms last week.

J. George Kaelber, of Denver, Colo., was a visitor at the Chicago Electric club rooms Monday.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	360	370
Central Union	44	45
Michigan	75	76
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	25	26
Missouri and Kansas	68	69

Business Mention.

Westinghouse, Church, Kerr & Co. have opened an office at 156 and 158 Lake street, Chicago, where they will conduct a general steam engineering business, in connection with the sale of the Westinghouse engine and the Roney mechanical stoker and smoke preventing furnace.

Electrical Patents.

Issued January 24, 1888.

376,730. Therapeutic Electric Belt. Samuel B. Bushfield, Denver. Colo.

376,818. Electrical Conductor. Thomas Egleston, New York, N. Y.

We give the claim: "A wire or conductor having applied directly to its surface an insulating covering of fibrous material impregnated with a liquid fire-proofing material composed of metallic oxide or oxides and a binding material, the impregnated fibrous material forming of itself the insulating covering for the wire, and also having applied to it an external water-proof covering of lead or fusible metal as a protection to the insulating material, substantially as herein described."

376,863. Electric Call. William H. Cutting, St. Louis, Mo.

376,880. Circuit-Closer and Regulator for Electro-Magnetic Thermoscopes. Henry J. Haight, New York, N. Y.

There are three claims of which we give the second: "In combination with the increasing-temperature and decreasing temperature keys or knobs; a shield plate adapted to cover and shield the keys or knobs and at the same time to close the entire circuit and to open the said return circuit when the said keys or knobs are uncovered by said plate."

376,893. Underground Conduit for Electric Wires. Ernest C. Lindemann, Baltimore, Md.

376,920. Watchman's Electric Controlling Apparatus. Ottokar Skrivan and Francis Dvorak, Vinohrady, Prague, Bohemia, Austria Hungary.

376,973. Mechanism for Electrical Connections. Peter W. Wood and John R. Wood, Montreal, Quebec, Canada.

This invention has reference to the construction of a mechanism placed in each station or location in a circuit and arranged so that the end or "ground" may be made through any such mechanism, so as to form a direct wire or line connection between the station operating and the station desired to be connected with any of the stations or locations connected in one circuit.

376,976. Electrical Switch. Sigmund Bergmann, New York, N.Y., and John Thos. Dempster, Summit, N.J.

The invention consists in a peculiar mechanism employed for producing the snap action of the switch, in the combination therewith of the elements of the switch, and in certain details of construction of the switch and its parts.

Eugene F. Phillips, President. W. H. Sawyer, Sec'y and Electrician.

American Electrical Works.

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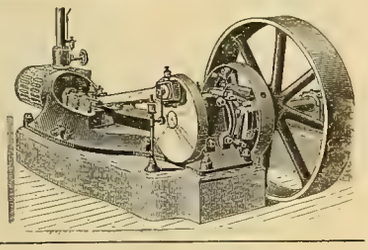

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The rubber used in insulating our wires and cables is specially chemically prepared, and *is guaranteed to be waterproof*, and *will not deteriorate, oxidize* or *crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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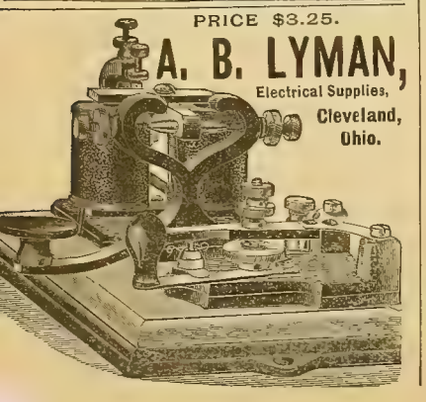

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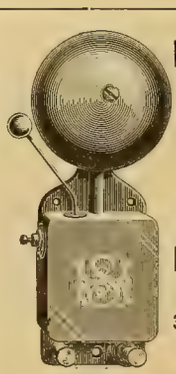

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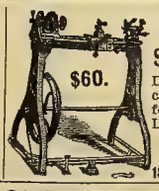

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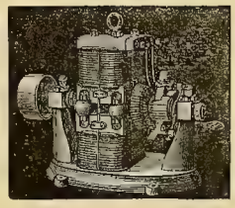

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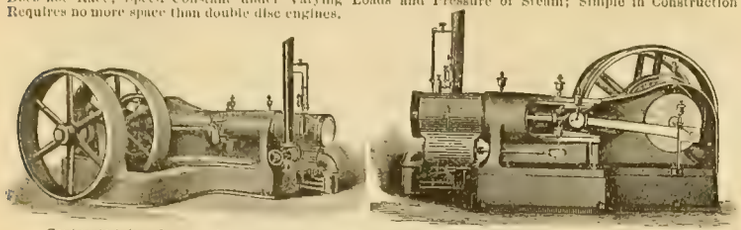

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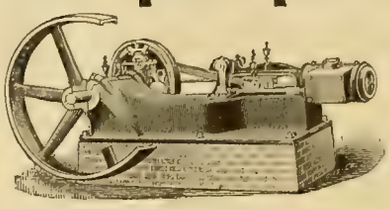

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Gentlemen: — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good time-keeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

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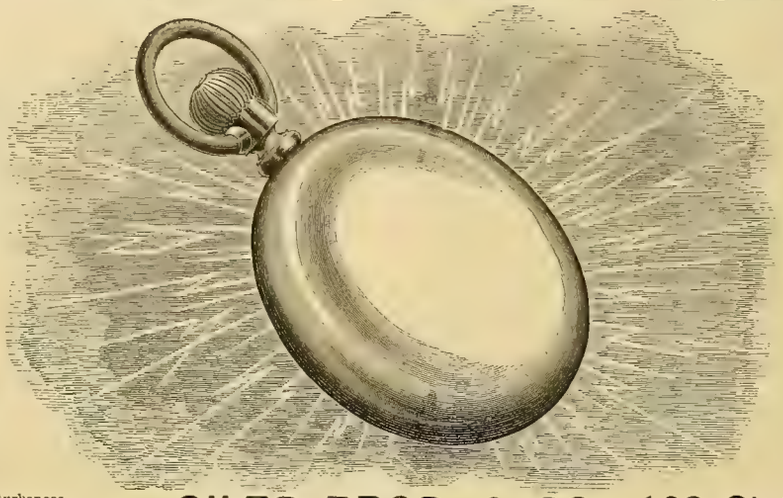
Electrician, V. D. P. E. M. Co.



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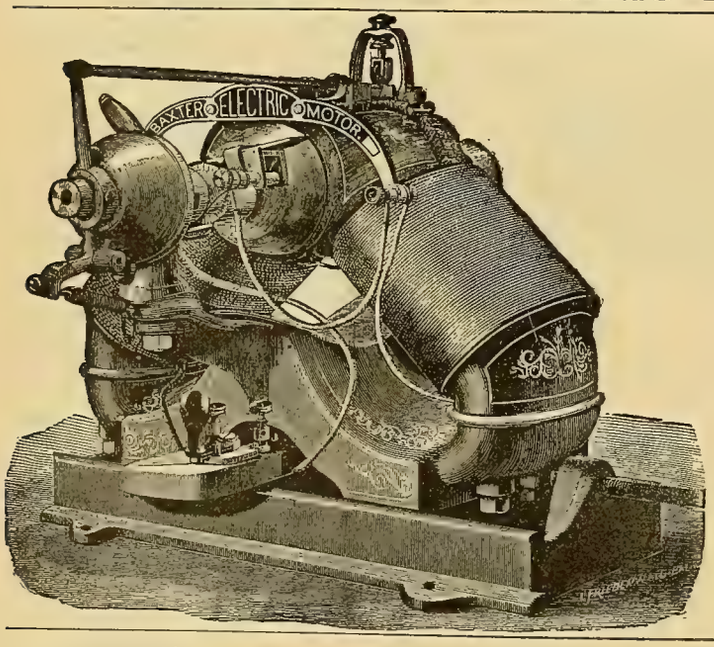

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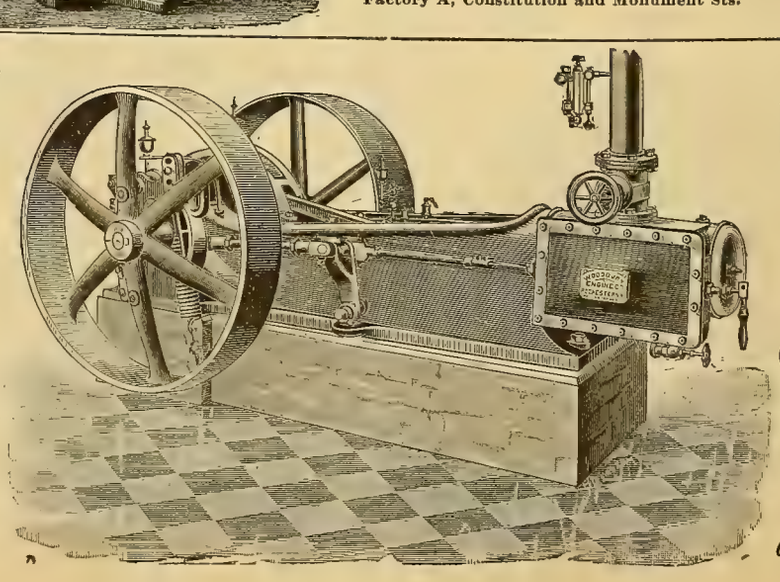

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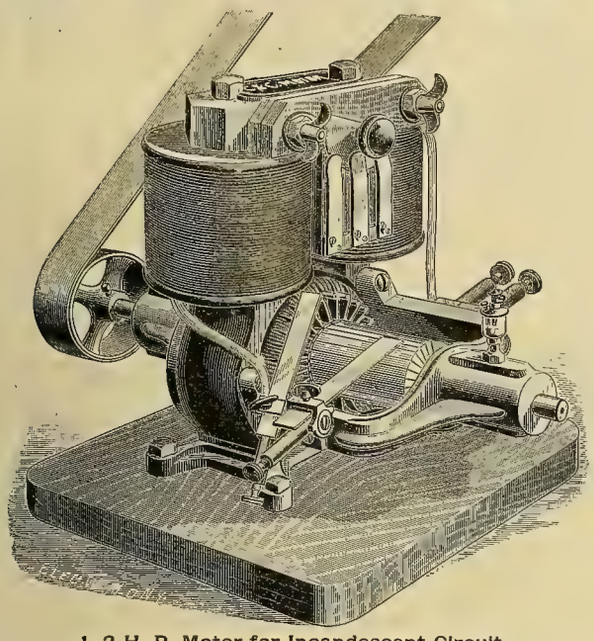

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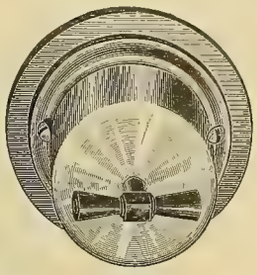

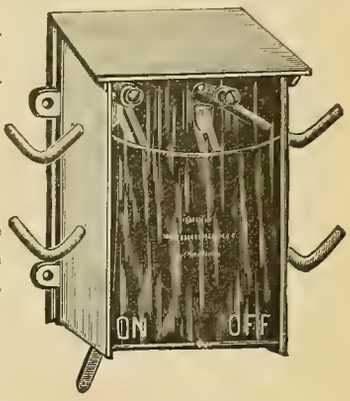

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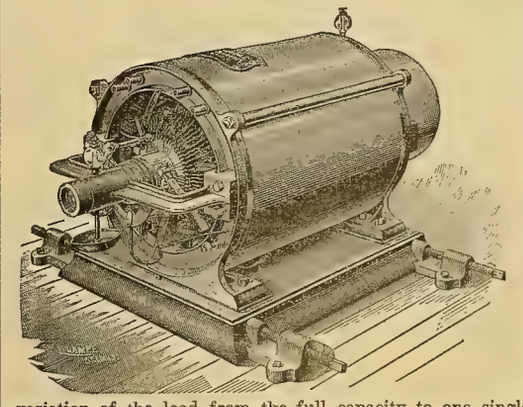

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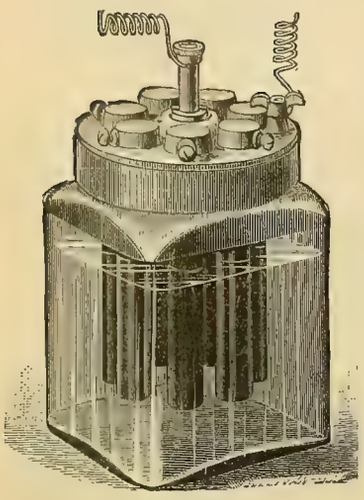

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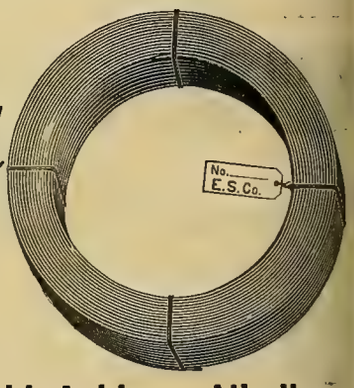

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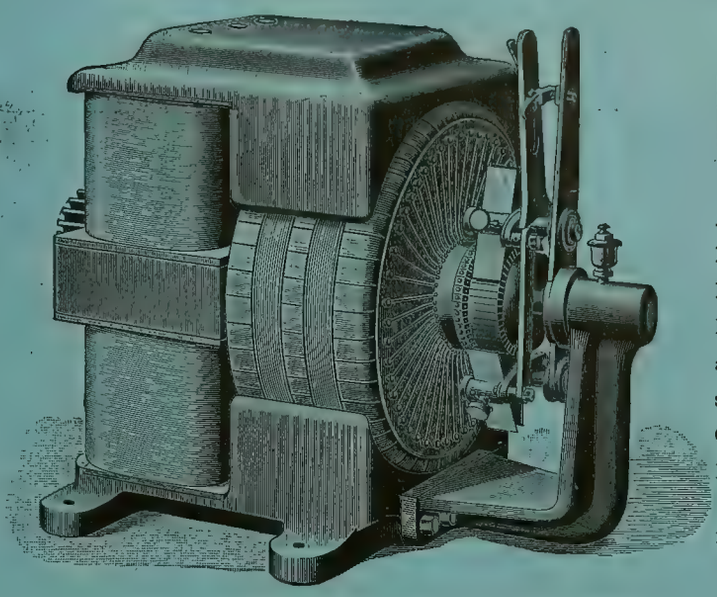

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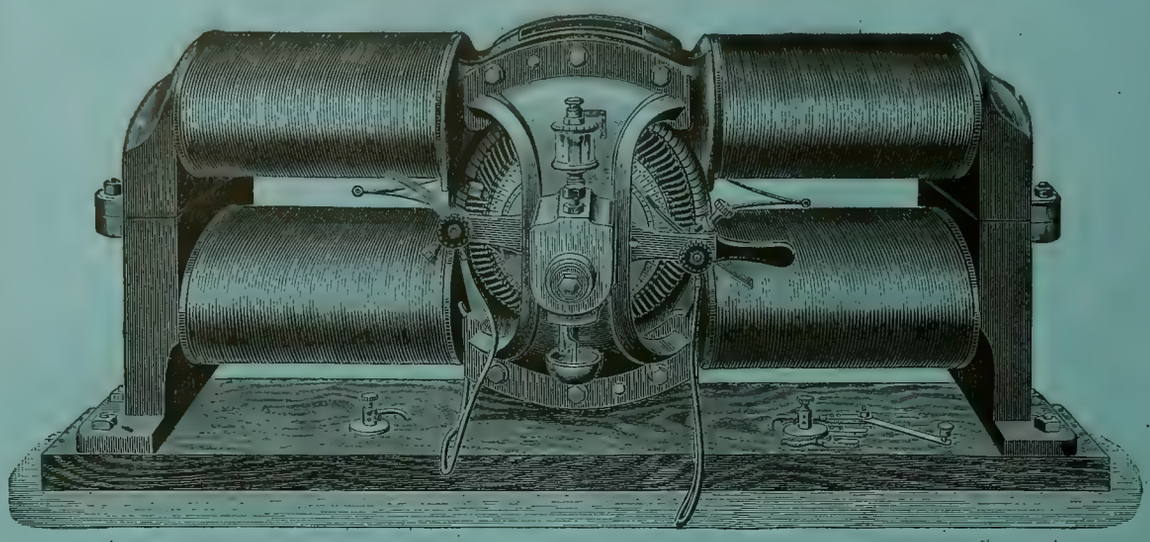

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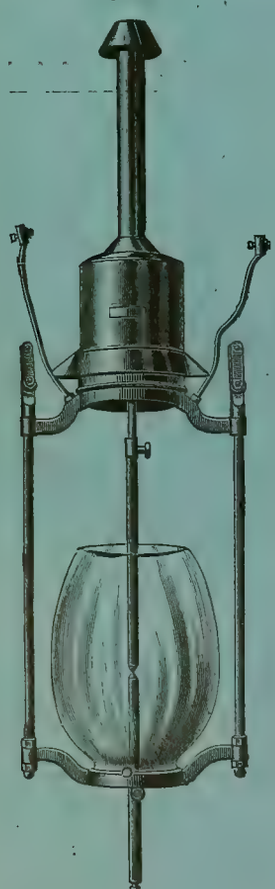

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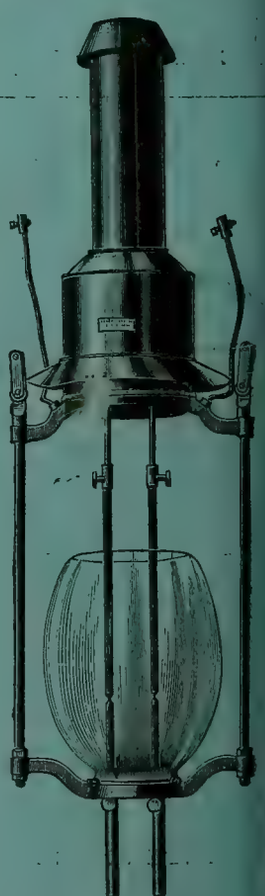

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Vol. II. CHICAGO, FEBRUARY 11, 1888. No. 6.

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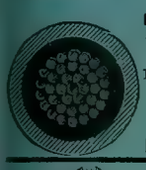

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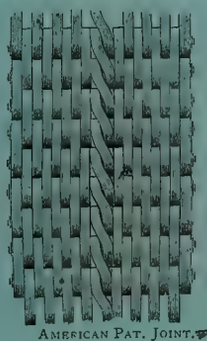

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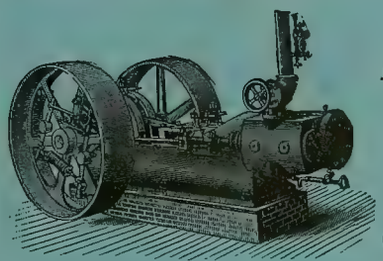

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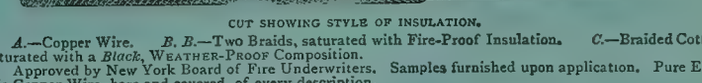

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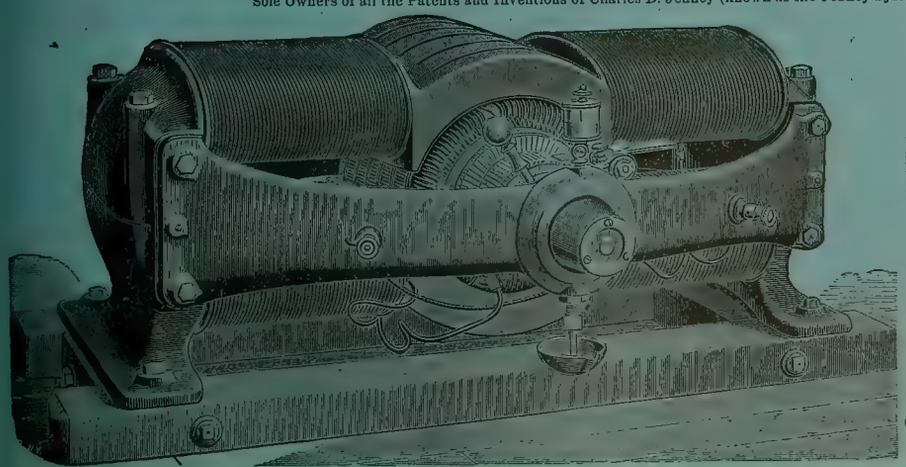

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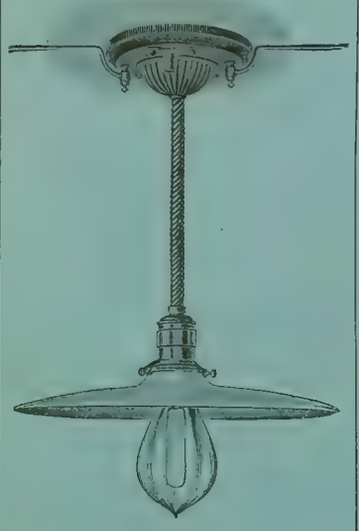

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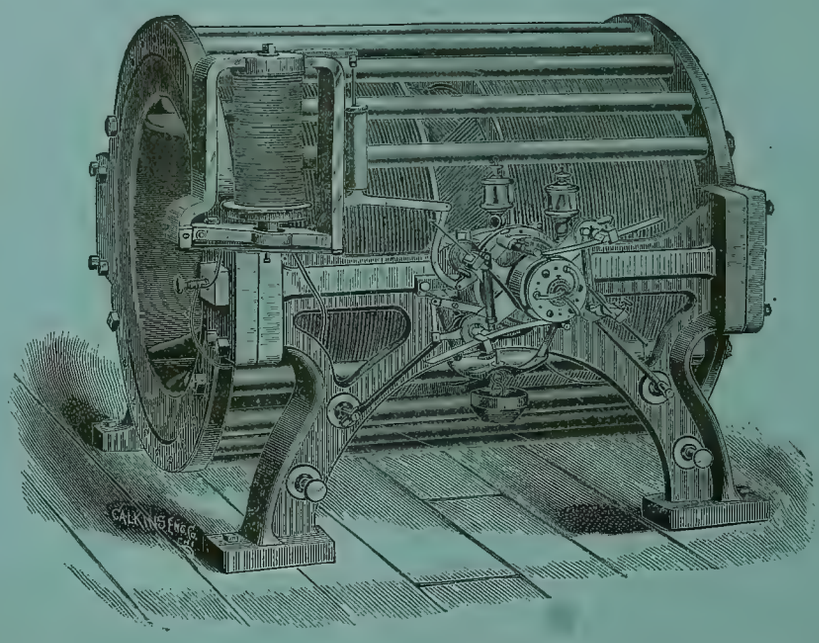

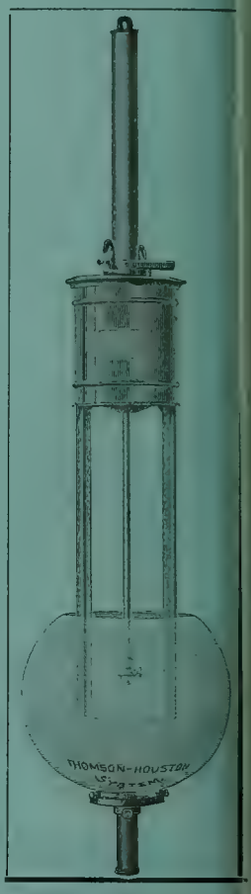

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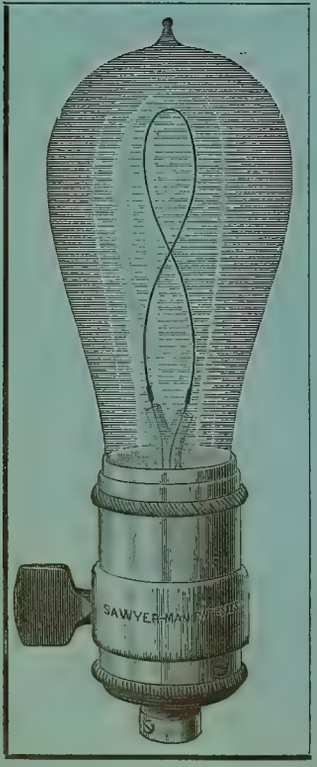

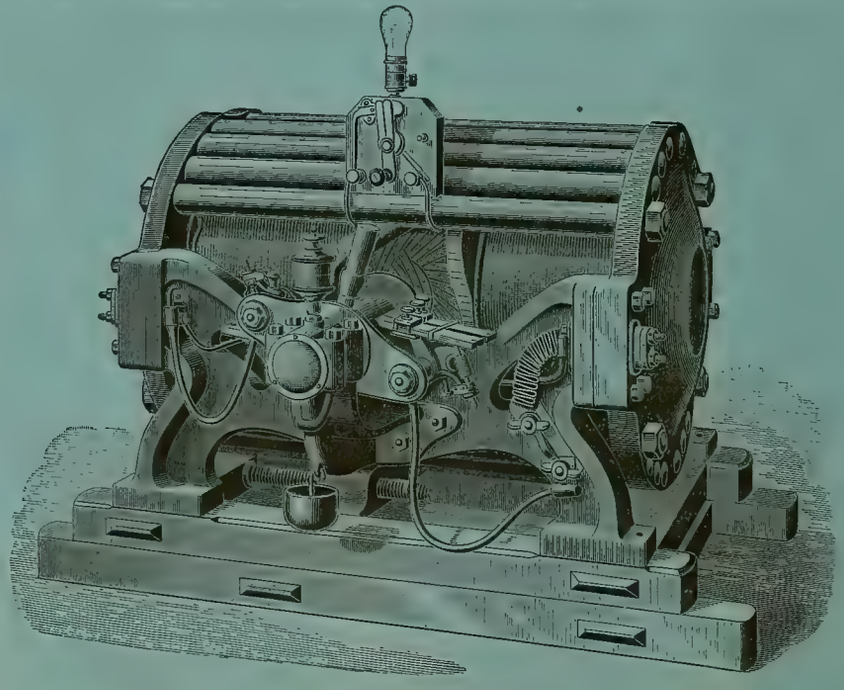

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Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

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IN

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12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

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WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of J. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=11$\frac{50}{100}$ per H. P.

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EDISON'S OPINION.

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Very truly,

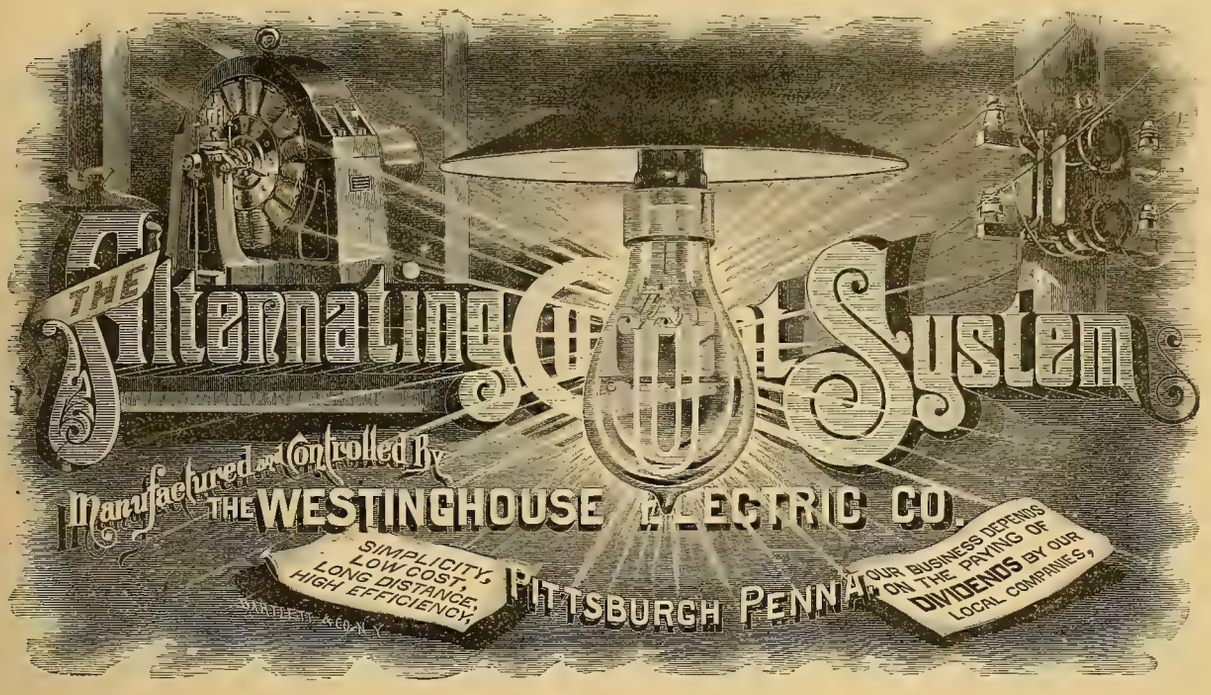
Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

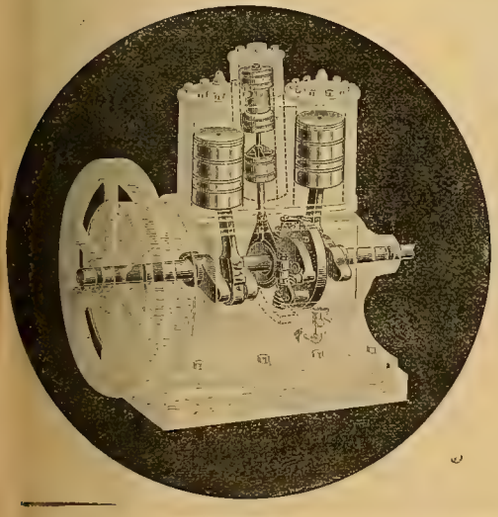
For Full Information about the Watches referred to in the above Testimonial, address:

Geneva Non-Magnetic Watch Co.

(LIMITED.)

177 & 179 Broadway, New York.





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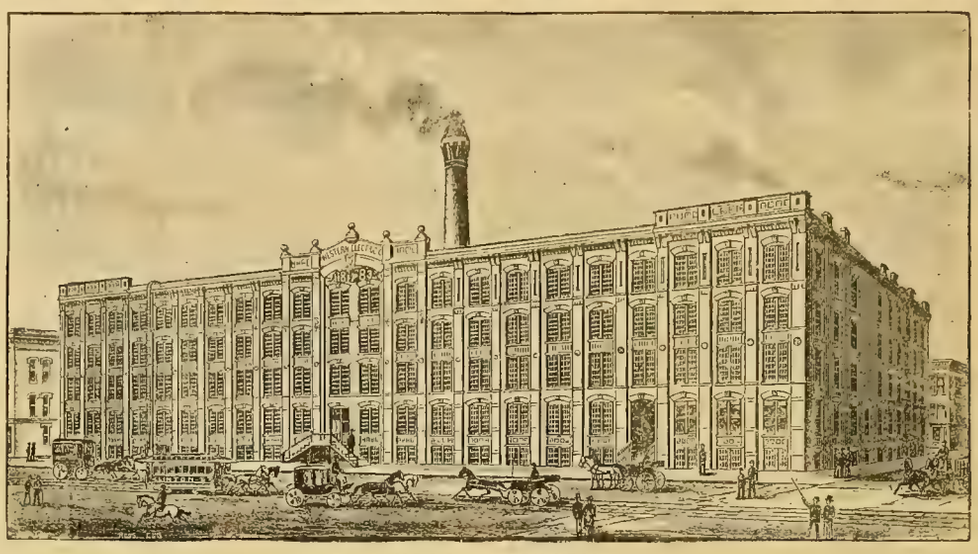

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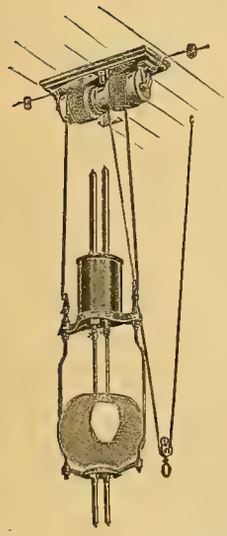

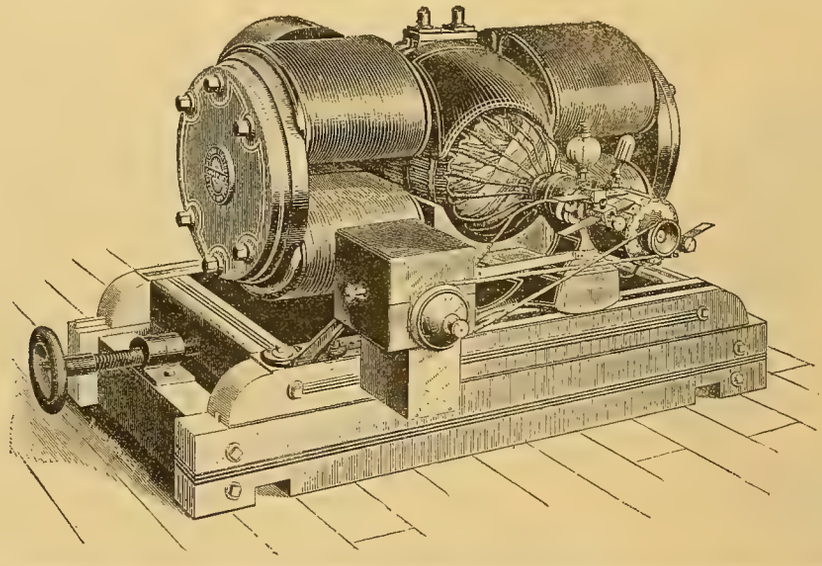

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Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even No. 16 gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes Nos. 13, 14, 15 and 16

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Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, FEBRUARY 11, 1888. No. 6.

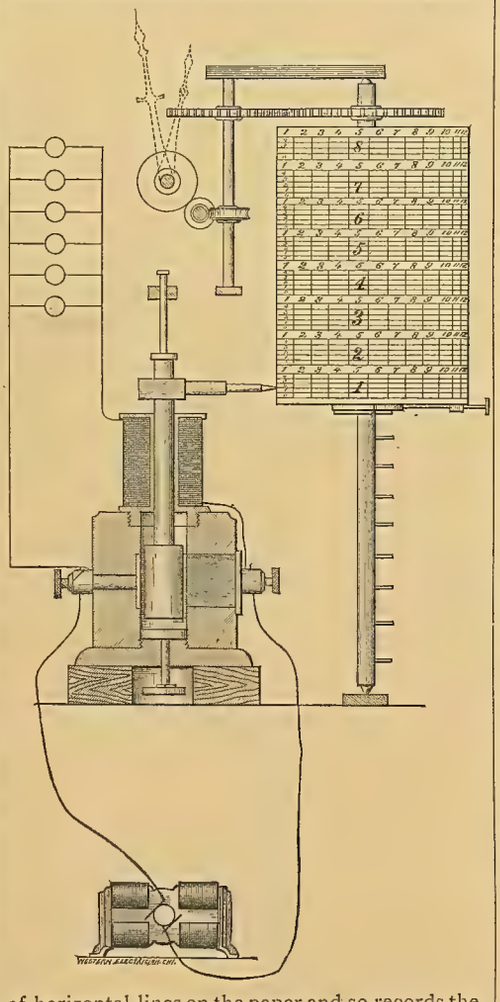
Irish's Regulator and Meter.

By W. E. Irish.

This apparatus consists simply and primarily of an electro-magnet, having a compound core which carries a plunger at one end and a pencil or marker at the other. The marker presses against a sheet of paper surrounding a cylinder driven by clockwork, on which it records the amount of electricity consumed in a unit of time, and the plunger causes the resistance of the main circuit to be regulated to suit the requirements of the shunt or local circuit. The plunger dips into an insulating well containing mercury; through one side of the well passes a wedge-shaped conductor of high resistance or a series of resistance rods which are sealed with their ends slightly projecting within and without the well, from the inside where they are in contact with mercury to the terminal on the outside. Inside the well and opposite the ends of the resistance rods is a plate of metal also in contact with the mercury and connected to an another outside terminal. The apparatus is inserted or joined up by cutting the main and connecting the two ends to the two terminals so that the current passes through the resistance rods, mercury in the well, and out again at the other terminal through the plate. The resistance of this arrangement when in its normal state or when the sub-main, local or shunt circuit is switched off is *nil*. On switching on or closing the local circuit which it is intended the meter should govern, and which is connected as a shunt between the two terminals to which the mains are connected, the electro-magnet which forms part of the local circuit becomes active and raises the plunger out of the mercury proportionately to the number of lamps introduced into the local circuit, causing the mercury in the well to fall, thereby increasing the resistance of the main also in proportion to the number of lamps lighted, or in proportion to the reduction in the resistance in the shunt circuit, which practically amounts to the same thing. The current or electric energy required to light the lamps in the local circuit is thus shunted, as it were, from the main circuit into the local, as required, by increasing the resistance at the point bridged by the mercury and resistance bars. For instance, supposing the topmost rod in the well to be equal to the resistance of one lamp, and one lamp only was lighted in the sub-section, then the resistance of the main would be increased to an exact proportionate extent, and so much more current would be sent through the shunt circuit. The greater number of lamps used, the greater, of course, must be the amount of current passing through the electro-magnet, as both are in the shunt circuit, and the greater will the resistance be at that point in the main bridged by the mercury and resistance rods. Under any circumstances the main and local circuit through the meter will always balance so long as they both remain closed. Every branch circuit is connected on one side to the incoming main, the circuit being through the electro-magnet and lamps back to the outgoing main, so that all the energy consumed must pass through the electro-magnet. This apparatus instantly regulates the current proportionally to the work required to be done on the local circuit and records the amount of electric energy passed through it or consumed in a unit of time.

These records are made on a drum driven by clockwork. The drum or cylinder is covered with a sheet of paper ruled in groups of horizontal lines, each line being numbered and representing one or more lamps; for instance, a group consisting of five lines may represent a circuit of five, ten, fifteen or twenty lamps, and the equally spaced vertical lines represent hours. The drum is timed to make one revolution every twenty-four, forty-eight, or other number of hours. As the plunger is raised and lowered by and in proportion to the amount of current passing through the electro-magnet, in the local circuit, so also is the marker operated and caused to record its movements on the paper.

The upper half of the compound core carries a holder in which there is a spring which exerts a constant steady pressure upon the pencil, the point of which presses continuously upon the sheet of paper. The core being acted upon by the current passing through the electro-magnet, moves the marker correspondingly over the group



of horizontal lines on the paper and so records the number of lamps burning during the number of hours represented by the marks crossing the vertical lines, and any variation at any time either in the increase or decrease of the number of lamps in circuit is shown by the rise or fall of the mark on the horizontal lines, and by the same action the time is also recorded. For instance, a mark made by the pencil on the second horizontal line of the group and from one vertical line to the next would represent that two lamps had been burning one hour. If the mark was then carried two bars lower to the fourth bar on the scale and across three and a half of the spaces between the perpendicular lines it would signify that four lamps had been burning three and a half hours and two lamps one hour.

The apparatus when once properly placed requires no regulating or adjustment as it automatically regulates the supply of current to meet the requirements of the circuit it is intended to govern. In principle all the instruments are alike, but, of course, one suitable for a small installation or residence would be scarcely suitable for a factory or other large installation.

The action of turning on the switch to light lamps in a shunt or local circuit also releases the clockwork which drives the cylinder of paper, and the plunger, and the act of switching off the current at the meter stops the clockwork and retains the plunger in its normal position. The current, when switched on by a consumer at the meter, will afterwards supply one lamp or the whole installation equally as effectively. If the clockwork is allowed to run when no lamps are burning the fact will be indicated by the record which would simply indicate that the clockwork had been working so many hours, during which no lamps had been burning. The apparatus accommodates itself to meet any requirements within its range and by its employment the consumer would not be called upon to pay for that which he has not used or had the benefit of, and the supplier would have the satisfaction of knowing where every unit of energy that had been generated was used. The more lamps lighted in a shunt circuit the greater will be the amount of current passing through the electro-magnet in the meter to supply them, and the greater will be the force acting upon the plunger to lift it from or depress it into the mercury, consequently the greater or less will be the increase in the resistance of the main circuit through the bridge formed by the resistance bars and the mercury. Thus the shunt circuit is automatically fed with the exact amount of electricity required for the lamps in circuit at the time and no more. At a central station the distributors may be connected between the mains and generators or accumulators, each main leading off from the meter or regulator through which the supply may be limited. The records of the main central distributors would equal the total record of all the other meters on that circuit. Thus it would not only act as a check but would furnish the officials with a ready record of the consumption on each and all the main circuits at all times. The same description of apparatus is employed in connection with the service of mains, sub-mains, factories, buildings and residences. This simple recording meter must be alike satisfactory to consumer and supplier. A clock face and pointer can if desired be connected to the apparatus so that the accuracy of the train of clockwork can be verified. The apparatus has the advantage of being reliable, economical, complete in itself, not liable to get out of order, automatic and simple in action and as well suited for a central station as a factory or residence. Beyond embodying these advantages it clearly records the exact amount of electric energy passing through it during any number of hours, weeks or months. It acts quite independent of the area over which the electric current is to be supplied. The current is never made or broken but simply varied in its local resistance. There is no danger to be feared from shocks or sparking. It governs the electric energy so completely that if 99 per cent. of the lamps in a circuit are suddenly switched off or on, the remainder burning would be unaffected, as the electric supply in the local circuit would have been as suddenly increased or reduced to exactly meet the requirements of the lamps burning.

Among the many advantages possessed by the

regulator and meter the few following are mentioned: It is operated by an expenditure of a minimum amount of electricity; it regulates the supply to meet the requirements of the circuit; it acts by a gradual varying resistance without breaking the main or branch circuits; it adjusts the supply of electricity from the main to meet the varied requirements of the branch circuit as more or less electric energy is required; it will divide the current between many circuits.

Non-Sparking Loop Switch.

The accompanying illustration shows a form of switch manufactured by the Electrical Supply company of 171 Randolph street, Chicago. It is

a loop switch, is non-sparking, and is inclosed in an iron box.

Practical Telephony.

By Thos. D. Lockwood.

Part V.

There are not many diseases which can be considered as local in the special arrangements described in Part IV.

Considering first the manually opened shunt circuit round the generator — that in which we have to push a button the same time that we turn the crank. I have never known any fault develop of its own accord in this device. I have known subscribers to open the door of the bell box and insert between the contacts of the shunt circuit-breaker a piece of paper, because they were too lazy to push the button; and what is worse, I have known those who considered themselves experts in telephony advise persons to do this, and show them how. It is a most pernicious practice, and should never be done. Why? Because it not only places the generator coils where they are easily attacked by lightning, but because it also introduces them in the case of bells at intermediate stations, actually into the talking circuit; and it is well known that electro-magnetic coils of wire in the telephone circuit oppose the conversation very strongly indeed for reasons already adverted to.

Now what faults are attributable to the automatic arrangement for breaking the shunt: Again not many. Occasionally the circuit-closing points do not make a perfect contact, in which case a portion of any ringing current coming from the distant station will pass through the shunt, and a portion through the generator. So also in conversation, if there are any intermediate bells, a portion of the talking current will pass through the generator, and the talking will be to a greater or less extent impeded. Sometimes also, but rarely, the mechanism operated by the crank, when turned, will fail to break the shunt. The only thing for the person who is hunting for the fault to do in these cases, is first to satisfy himself of its true nature, and then if the trouble can readily be reached, remedy it in the way which suggests itself on the special occasion as being the best one; but if this can not readily be done in a permanent way, it should not be left to make future trouble,but the bell box should at once be changed.

We will now consider the case of the automatic switch: This appliance has been the seat of more trouble and complaint, than all the rest of the bell box mechanism put together. The force pulling the switch one way, so as to connect the line through the bell is of course the weight of the telephone; and the force tending to pull the switch the other way so as to connect the line with the telephone is usually a spring. These must certainly oppose each other; and must be so proportioned that the spring while strong enough to pull the switch firmly and strongly over to the telephone contact when the telephone receiver is taken from the hook or yoke, must by no means be too strong to be overcome by the weight of the telephone when in place.

The faults which are likely to afflict this part of the mechanism are various; but they may all be summed up under the two heads of infirm or mechanically imperfect contacts; and oxidized and dirty contacts. The principal and most important contact in the switch is that which connects the line with the switch bar. Why?

Because this connection comes in play, whether the bell or the telephone branch be in circuit, and forms a part of both. Consequently it must be closely looked after, and any sign of decrepitude must be promptly handled. If made by a spring contact, the spring must be so placed that it will maintain a good electrical connection, without imposing much mechanical strain. But it is not necessary to give details of inspection here, as when attention is called to this point, any fault is clearly manifested and the proper mode of treatment will readily suggest itself. If the main line connection be made through the fulcrum standard of the switch, and the circuit passes through pivots or trunnions a light curled wire should be attached by its ends to the metal on both sides of the trunnions so as to shunt them. The switch sometimes does not make firm contact with the spring leading to the bell branch; when this occurs the counter-spring must be slackened a little. Or again it does not always make a good contact with the telephone contact spring; in this case the counter-force spring must be tightened up. This counter-spring is one of the most important features of the switch and must be kept up to the highest point of good order. The contact surfaces should be kept very clean, and ought to be periodically and systematically looked to and cleaned if necessary.

It appears to me to be an excellent plan to so arrange the circuits of the bell box that the telephones when not in use — that is, when the switch is placed so as to connect the line with the bell — are not totally disconnected but shunted out of circuit; and that in like manner when the telephones are being used the bell and generator are shunted by the portion of the telephone circuit which goes through the switch contact. By this arrangement the chances of trouble arising from faulty contacts are minimized. One way of doing this, is to have the connecting wires and bell circuits arranged as in the diagram Fig. 9, but there are several ways in which it can be done.

The several distinct appliances which are comprised in the bell box have now been severally considered, and it may be that some of my readers have come to the opinion not only that "the way was long, the wind was cold," but also that the "minstrel was infirm and old." For the minstrel, I may say, that his readers must remember the difficulty of describing the dry and soul-harrowing details of a telephone box in an entertaining and attractive manner; and believe that he has been doing his best.

In addition to what has been said, it is a good general observation, that telephone inspectors, and others who have much to do with magneto bells and such "critters" should never take it for granted that the electrical connections of any two bells are alike. There may be trifling changes, but in looking after faults in electrical apparatus no change can be properly regarded as trifling. When a new bell is to be considered with a view of finding a trouble or of locating the character of a fault, common sense dictates that a knowledge of the ground is the first thing to be acquired. And so if I were new to the business and wanted to know how the wires of the bell box were run, so that I could determine the nature and location of faults, I should argue the case to myself something as follows: The two binding screws at which the two line wires, or the line and ground wire are to be attached are clearly the two terminals of the bell box circuits. By means of the appliances contained in this box I can receive a call from a distant point on the bell which forms a part of it; and I can by turning the handle, generate currents of electricity which passing over the line will ring a distant bell in the same way. If I connect the two screw posts on the top of the box by a wire, the effect is the same as if I had connected them with the two ends of a short line, and by doing this I can test my bell box as much as I please. When I turn the crank the bell attached to the same box also rings; and moreover all this happens when the projecting hook switch is in its lowest position. If there is a button on the side of the bell I find by further trial that when I turn the crank I must also press this button or the bell will not ring. Looking further I find that if no such button is there, there is in place thereof, something which does the same work, but which is operated automatically by the simple act of turning the crank. And finally, I find other screw posts marked for the wires or flexible cords leading to the transmitter receiver and battery. I observe in cases of bell boxes that are already in use, that when the line is not in use, the telephone hangs upon the yoke end of the switch bar which projects from the box; and that furthermore when conversation is going on, the telephone is taken from its support, and the switch bar, relieved from its weight, flies upward. Now I can think over these observations and make my deductions from them which will lead me in all probability to a proper understanding of the apparatus. I say, to myself "as the bell rings and as I can by turning the crank ring it when the telephone is in place and the hook down, I have good reason to believe that the bell magnet and generator are, as long as the switch is in its lowest position, actually in the main line circuit; also that the said circuit passes through the said switch, and through something with which that switch makes contact when in its lower position; also that as I know the generator coils ought not on account of its resistance and for other reasons to be in circuit the generator is shunted out of circuit, when at rest, by means of a loop of wire which is controlled either by a push button, or by an automatic circuit breaker." Tracing now the circuit with these deductions before me, I find them all to be true. I may now assume, inasmuch as in tracing the bell connec-

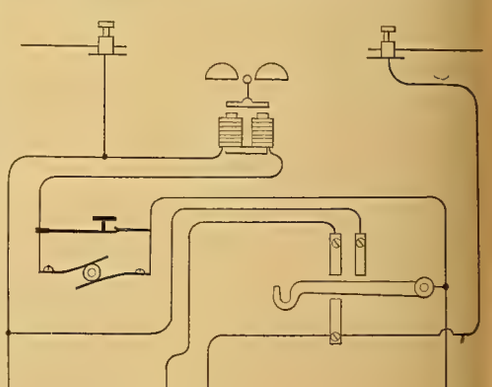


Fig. 9

tions, I failed to find that the bell circuit ran also through the telephone, and that as when the switch is in its upper position the telephones are evidently in the main-line because we can use them for speaking with a distant correspondent, there is a separate wire for the said telephones, and that furthermore it also, leads through the switch for transfer purposes. Tracing the wires carefully, we find this is true. From one of the main line screw posts the circuit may be traced as before to the switch, then from one of the upper or back contacts of the switch through the receiving and transmitting telephones, and then to a wire leading to the remaining main line post. Finally we see that in practice the primary or battery circuit is led up into the box. There can only be one possible reason for that; namely; to arrange that it also shall be under the control of the switch, being automatically opened when the switch connects with the bell branch, and automatically closed when the switch connects the main line with the telephone branch. The examination proves the truth of this hypothesis

also. Having proved all this to our satisfaction, both by considering what ought to be, and then what is, we have little left to learn of the "innards" of the bell box; and ought by a little reflection and care, to be able to figure out the character and location of any fault.

Here I throw in two moral remarks; First, Never pull a bell or any other electrical appliance to pieces, until you are perfectly sure of what you are looking for, and reasonably sure of where you will find it.

Second. Keep a bright lookout on hinge connections.

The bell box when set up is usually mounted on the upper part of the baseboard, while the battery box is generally affixed to the lower part of the board, leaving a place for the Blake transmitter between them. There is really no special reason for this arrangement except that it has been found convenient to keep the battery close to the mechanism. If it is placed in a separate box on the floor, it is apt to be kicked over. It is also convenient because the battery and other wires can all be arranged before the apparatus is taken from the central station. As to the general shape of the baseboard and apparatus, I may say that there is no special reason for that either. Somebody made it up in that shape first, and everybody else, like so many sheep following a bell-wether, forthwith followed closely in the same style. It is getting rather monotonous though.

When "continued in our next," I shall have something to say about "telephones," by which I mean both receivers and transmitters.

(*To be continued.*)

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number XXIX.

The Brush Arc Light Lamp.—Among the numerous excellent arc light lamps which have

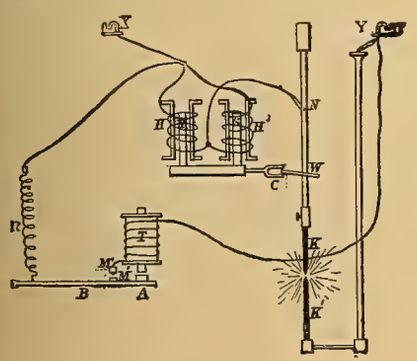


Fig. 66.

been constructed, the Brush may be selected as an example of simplicity and adaptation to the purpose for which it was designed.

Fig. 66 is an ideal illustration of the construction, from which it will be seen that the adjustment of the carbons depends solely on the attraction of a solenoid, without the intervention of clock-work or gearing. *X* and *Y* are the terminals of the electric circuit, *K* and *K'* the carbons; the lower carbon holder, connected with *Y*, has a fixed position, while the upper holder, connected with *X*, is free to move vertically. This movement is produced by the solenoids *HH'*, each of which is wound with coarse copper wire and placed in the main circuit by connections at *X* and *Y*. At the right of *X* are shown three branches, one extending to a resistance coil *R*, and the other two, after being coiled round the bobbins *HH'*, reunite as shown, and connect with the upper holder at *N*, the connection with *Y*, being through the carbons *KK'*.

A shunt of fine copper wire, not shown in the cut, is connected directly with the terminals *X* and *Y*, so that the current through it does not pass through the carbons. This shunt is coiled round the bobbins *HH'* outside of the coarse wire, but in reverse order, so that the currents through it and through the coarse wire, from *X* to *Y*, pass through the coils in opposite directions, and tend to neutralize each other. This shunt, having a high resistance, carries about one per cent. of the entire current, but its coils being much more numerous than the low resistance coils, their magnetic effect is proportionately increased.

The carbons being in contact at the start, and the main current passing through them and through the low resistance coil, the cores of the

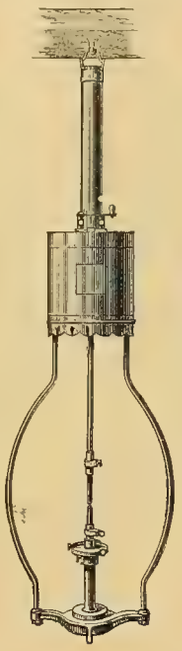


Fig. 68.

solenoids are attracted, lifting the clutch *C*, which grips the edge of the loose washer *W*, which being tilted at an angle, as shown, grips the upper holder and lifts the carbon *K*, forming the arc. The separation of the carbons increases the resistance in the main circuit, and diverts more current to the shunt, which by its opposition to the main current reduces the magnetic attraction, and checks the ascent of the upper carbon when the arc has attained its normal length. A reduction of resistance from any cause, sends more current through the main circuit, increasing the distance between the carbons and consequently the resistance. Thus by the action of these opposing currents, the normal length of the arc is maintained; and this normal length may be adjusted as required by varying the relative resistances of the two circuits when the lamp is constructed; so that it can be maintained at $\frac{1}{16}$ of an inch, $\frac{1}{8}$ of an inch, or any other length required by the candle power of the lamp. If a lamp becomes accidentally extinguished, the relative change of resistance in the two circuits operates to bring the carbons together, and the light is instantly renewed. Sudden fluctuations in this series of adjustments, which would produce a flickering,

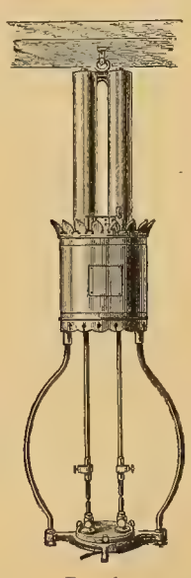


Fig. 69.

unsteady light, are obviated by connecting the armature of the solenoid and the upper carbon holder with pistons moving in tubes filled with glycerine, by which smoothness and steadiness is imparted to the movements.

Fig. 66 shows also a short-circuiting apparatus by which, in case of a lamp from any cause becoming permanently extinguished, it is short-circuited, so that the flow of current to other lamps on the same circuit is not interrupted. This apparatus consists of a resistance coil, *R*, and an electro-magnet, *T*, wound with coarse wire, placed in a direct open circuit between the terminals *X* and *Y*, as shown, through the hinged lever *B* and armature *A*. In addition to this open circuit, there is also a closed circuit of fine wire, wound on the bobbin *T*, in the same direction as the coarse wire, and forming part of the fine wire shunt of the solenoids *HH'*. The ordinary current through this shunt, by which the lamp is regulated, is not sufficient to attract the armature *A*, but if the lamp should happen to be permanently extinguished the resulting increase of current attracts *A*, and closes the coarse wire circuit through the contacts *MM'*, so that the main current flows past the extinguished lamp to the other lamps on the same circuit. By adapting the resistance of *R* and the windings of the bobbin *T* to the strength of the current, the requisite adjustment can be obtained.

The carbons, 12 inches long, last about eight hours, about three-fourths of the positive carbon and one third of the negative being consumed. The lamps are usually constructed with either one or two pairs of carbons, but can be made with three or more pairs if necessary, and, by the simple device shown in Fig. 67, each pair is lighted in succession automatically when the pair previously lighted has burnt out. The frame K, which is connected with the solenoids, is adapted to two pairs of carbons; the clutch on the right is on a little higher level than the one on the left, it consequently grips the washer W^2 and lifts the carbon-holder R^2 before the left clutch can grip W' and lift R^1; the current, which at first passes equally through both pairs of carbons

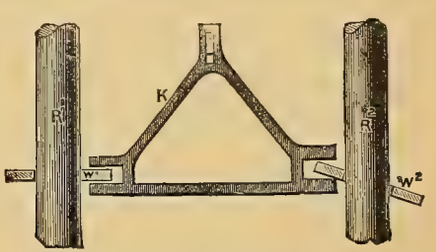


Fig. 67.

is now, in consequence of the separation of the right pair, diverted through the left pair alone; the frame continues to rise, the left pair are separated and the arc established.

The separation of the right pair is too great to admit of the formation of the arc, but when the left pair is so far consumed that the light is extinguished and they can no longer be brought together for relighting, the right pair is brought into contact and the arc re-established automatically, less than a second being required to renew the light. Fig. 68 represents a single lamp and Fig. 69 a double lamp; the controlling and regulating apparatus being enclosed in the circular case above the carbons.

In the consumption of arc light carbons, cones of half to five-eighths of an inch in length are maintained on both carbons, that of the lower carbon being pointed, while that of the upper carbon is truncated, the crater occupying about one third of the diameter. As these cones are incandescent, light is radiated from a space, including the arc, of an inch or more in length, while the actual distance to which the carbons are separated is only $\frac{1}{16}$ to $\frac{1}{8}$ of an inch; the incandescence of the upper + carbon is more intense and yields much more light than that of the lower — carbon.

In Number xxviii of this series published last week, the references in Fig. 65 market n n_1 n_2 should have been h h_1 h_2.

Fourteen petitions have been presented to the municipality of Madrid to use the public thoroughfares for laying cables for the supply of electric light and power.

Transmission of Power by Rope.

The subject of rope transmission of power is one that is claiming attention among electric light men, especially those interested in large stations. The Chicago Arc Light & Power company is now running one of these systems, and your correspondent is informed that they are well pleased with its operation.

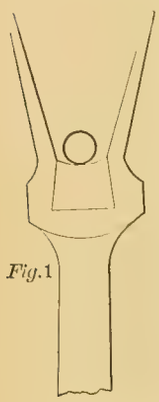


Fig. 1

The transmission of power by wire or hemp rope is in the use of an endless rope running at great speed over a grooved wheel, in place of a leather belt running over a flat faced pulley. This above method of transmitting power over long distances is by no means a new one, though in practice, it may be said that in is comparatively new, as its adoption has been of such slow progress as to occupy but little room in the everyday practice of millwrights and engineers.

The principle, however, is rapidly gaining favor, and the future for the transmission of power by rope may be pronounced very broad. Its application ranges anywhere from twenty feet up to over three miles, and in point of first cost can not be approached by any other method, as will be seen later. The method dates back to the year 1850, and is in extensive use all over Europe, but it has in this country but recently come into general use. The variety of methods for applying the use of ropes in transmitting power, are too many to enable us to describe all; a few of the principal points however, will suffice to enable the user to observe the necessary points in its successful manipulation.

In places that are sheltered from the weather, hemp or cotton rope will answer for all purposes. but in transmitting power from one building to another it will be necessary to use wire rope

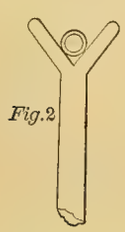


Fig. 2

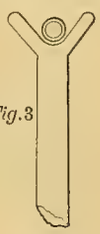


Fig. 3

with a hemp core, for each of these purposes a different kind of pulley or wheel will be required, in the case of the wire rope it is necessary to line the yoke or tread of the wheel with some soft substance to prevent abrasion and slipping, which would very soon result in the entire wearing out of the rope. For this purpose several substances have been used, chief among them being wood, leather and rubber; in order that these or any other material for that purpose can be easily secured to the wheel, it is necessary that the tread of the wheel shall be cast in the shape of an inverted wedge, as shown in Fig. 1; the pieces of wood are then cut to fit this cavity and are let into it through a square opening, generally made at a point on its edge for that purpose, each piece is driven in after its neighbor until the entire groove is filled up. The chief objection to wood however, is that it is susceptible to moisture and liable to fly out. Leather filling has been found to answer a good purpose, but it has the serious objection of requiring, on a large wheel, several thousand pieces, which have to be stamped out with a punch made for that purpose, and requiring many hours to place them on edge

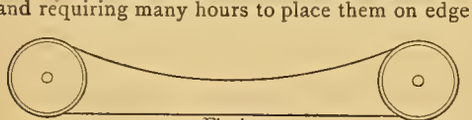


Fig. 4

in the groove of the wheel. Probably the cheapest form of filling will be found in strips of hard rubber, which can be made in lengths and formed to fit the cavity tightly, and driven into place by a wooden hammer, the rubber is impervious to moisture and forms an excellent surface for the rope; Fig. 1 represents a cross section of a sheeve fitted with a soft filling and with a rope in position.

As will be seen by this sketch, considerable room exists between the sides of the rope and the sides of the flange of the wheel, this, with wire rope has been found the best practice, as a closely fitting groove has been found to greatly reduce the longevity of the rope by the consequent friction of the sides in contact, and which does not appear to be of such importance in the use of hemp rope, in the use of which it is best to turn the grooves of the wheel a trifle smaller than the diameter of the new rope.

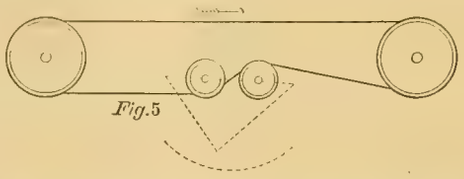


Fig. 5

Many mistakes are sometimes made in this matter, and the system is frequently blamed for what is nothing more than carelessness on the part of the designer or millwright, as will be seen in Fig. 2, which shows a pulley with a plain V in its periphery, which is frequently done without any regard to the size of the rope that is to run over it; it is needless to say that such practices can not help matters any. The rope should fit in the groove in a manner represented in Fig. 3, where one third the circumference of the rope is brought in contact with the face of the grove. It is the practice of some to square the grooves, bringing two sides and a bottom to bear against the sides of the rope, but as this has a tendency to ultimately change the form of the rope, it can not be recommended; the round grove will be found to give the most satisfaction and the least trouble, and is much easier on the splice.

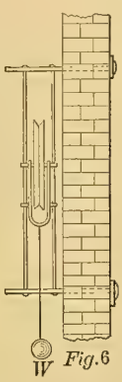


Fig. 6

In transmitting by rope, one important feature must be observed, and that is an arrangement for taking up the slack, which will be found to be considerable with hemp or cotton; in cases where no great distance is to be traversed, and there is plenty of head room, probably no provision may be found necessary, in which case the slack side can be run on top as shown in Fig. 4, as it is necessary in this method to use as large pulleys as possible, the larger the better, the distance between the top and bottom of the pulleys will be found to be sufficient after the slack has been taken out of the rope. It will however be found good practice whether there be a tension wheel or not on the system, to take the slack out of new rope before splicing, as there is so much give to a long length that unless the tension wheel has considerable travel the rope will require taking up before running long, which with a long splice is not always convenient. The easiest method of taking out the slack is to run the rope one or more times according to its length, between two points, and hang a weight in the center, and allow it to remain there as long as possible, and occasionally applying a little weight with the hands. Another way of accomplishing the same result is to bend the rope around the wheels it is to run on and twine the ends together and apply the weight, this however can not always be done, as the wheels may be in motion; either way however will answer the purpose and the remaining slack can then be cared for by tension wheel.

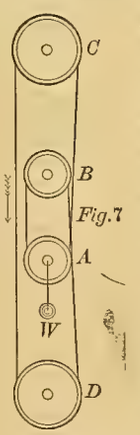


Fig. 7

Where there is a run of seventy-five or a hundred feet it will be found necessary to use a tension wheel of some kind: for such a purpose and for a single line the most simple form in the practice we have known, is shown in Fig. 5, and where the head room will not permit of the pull side being down, the tension wheels can be placed on the bottom.

The sketch represents two small wheels whose diameters should not be less than half the diameter of the driver, the wheels should be swung in an iron frame, and hung to swing round each other, the frame can be operated by a short lever placed in the most convenient position, and a light tension kept on the end of the lever by means of a cast iron weight; of course the rope should be put on as tight as possible before the wheels are allowed to bear upon it, as it is advantageous that the rope should have as little turn around these wheels as possible. The tension wheels can be hung in a light wooden frame suspended from the ceiling, or if the pulleys be close to a wall, they can be bolted through the brickwork to advantage.

The various forms of tension wheels that may be employed are many, and it will not be out of place to enumerate a few of the most important, which although differing in structure are an embodiment of the same principle; as we have explained, tension wheels are not always necessary though it will be seen that in nearly every case they are essential, there are however, some cases as will be seen later on, where they can be dispensed with.

All that is necessary in the use of the tension wheel, is to merely take up and pay out the amount of elongation in the rope, consequent upon expansion and contraction by different degrees of moisture and the variation by the load, therefore any excess of pressure above this amount will bring an unnecessary strain upon the rope, and decrease its length of life. In cases where the power is to be transmitted vertically it will be found that very little will be required above the weight of the tension wheel and frame, and more especially where the power to be transmitted is light and steady. Fig. 6 is a favorite form of tension wheel and frame used in case of vertical arrangement, and is shown bolted to a brick wall; in this instance it was required to transmit ten horse power, from the basement of a building up to the third floor, and this tension wheel was placed on the wall of the first floor, the ends of the shafts being extended to reach the wall of the building, the ropes passing up through the benches of the workmen, on each floor, holes were cut through the floors and benches and two inch ferrules were fitted in, through which the rope passed, at the benches the ferules were extended up about a foot, to

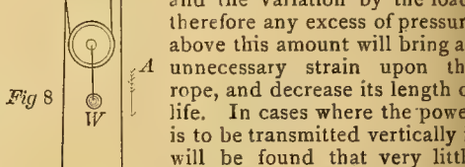


Fig 8

Fig. 9

prevent the workmen from throwing tools, etc. against the rope.

The wheels on the driving and driven shafts were two feet in diameter, and made 190 turns per minute; the rope used was one inch in diameter, and was laid over with a long splice 6 feet in length — 3 strands—about two feet of stretch was taken out of the rope before splicing, which brought the top of the tension wheel close up to the top of the frame; at the expiration of a week the elongation of the rope brought the position of the tension wheel about central in the frame, as shown in the sketch, where it now runs, smoothly and noiselessly. After the rope was spliced and ready to run, it was slightly greased with tallow, or better, painted with boiled oil and

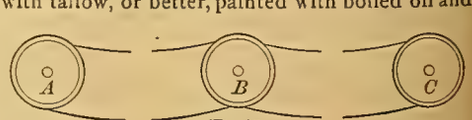


Fig. 10

mineral paint, to allay the absorption of moisture.

The method of construction of the tension frame in question was as follows: The wheel was fitted to a yoke of 2 x ½" bar iron and ⅝" eye bolts tapped in each side, of which there were four; these eye bolts were bored for ⅞ rod iron, which passed through them to act as guides, two lengths of ⅞" rod iron was then

taken, about six foot long, and securely riveted at their ends into two lengths of the same iron that formed the yoke, the ends of these were reduced to receive a nut and washer, by which they were secured to the outside of the wall; W represents a weight of about fifteen pounds which was attached to the bottom of the yoke by a small rod, which passed through a hole in the lower wall piece and below the center of the yoke, the eye bolts in the yoke were drilled to allow the frame to move up and down the rods freely. The cost of the job, including the wheel was about $12.00, which would of course be no greater if the distance to be transmitted was four times what it was in this instance.

In cases where it is not convenient to extend the ends of the shafting to the walls, the frame can be suspended from the ceiling, in an out of the way place or down by the side of a post, with the same results as in this case; in arranging the tension wheel, care should be taken that the rope leads off directly from the center of the wheel, as at high speed it will jump off very easily if allowed to swing from side to side. Fig. 7, is an elevation of the arrangement, reduced between centers, in which A is the tension wheel and B is the idler, C is the driven and D is the driving wheel; idler B must be bolted to the wall the same as the frame of the tension wheel, except that it is stationary, while the centers of D must pass between those of A and B, in order to allow the rope to pass from one to the other. As will be seen, this arrangement will permit of an extension vertically to an almost indefinite length, the only necessary change being in a slight increase in the diameter of the pulleys, and a corresponding increase in the weight W to counteract the weight of the rope and bring it to bear against the face of the lower wheel, which however is very slight.

Another method of arriving at the same results as above described, is shown in Fig. 8, in which D is the driver, C the driven, B the idler and A the tension wheel. In this arrangement it will be noticed that the idler is bored out to run on the driven shaft, the inside hubs of the wheels B and C are turned off to a face, the wheel C is keyed or set-screwed to the shaft, and the idler B is kept up to it by a collar, the shaft forming a journal; the tension wheel A, will perform the same office as in Fig. 7, with the exception that it will be found necessary to permit of a greater distance between it and the idler, as the distance between the centers will be greater in this instance than in the one previously described; as will be noticed, the center of the tension wheel is directly under that of the idler, this is not absolutely necessary, as the opposite sides will have to correspond with the opposite sides of wheels B and C. The question of lubricating wheel B will be found to be a matter of little importance, as the shaft is traveling in the same direction as the wheel itself, and the number of revolutions is therefore only what the difference between the diameter of the two wheels may be, in fact, as the only point for using smaller wheels for idlers and tension is the cost in price, there is no objection to the wheels being the same diameter all round, in which case the two wheels B and C can be both keyed to the shaft, and no lubrication required except for the tension wheel.

Fig. 9 is the same method employed horizontally from one shaft to another, either in the same building or from one building to another, across an alley or otherwise; in this case tension wheel A can be suspended from the ceiling or joists, and the tension kept upon it by means of a larger weight over a small pulley; the size of the weight in this instance will have to be much greater than in the cases explained above, as the weight itself is all the tension there is on the rope; in in cases of this kind it is the practice of some to make the tension wheels stationary in the guides, and to take up the slack by means of a screw, this however can not be recommended as the difference in tension must then be taken out of the rope, which consequently suffers, and it is no cheaper, as the cost of the screw and attachments will be found to more than balance the cost of the weight and wheel, over which it runs. In this case it is also optional as to whether the size of the idler is as great as that of the driven wheel.

We would prefer to make the idler loose on the shaft, as it will be seen that tightening it on the shaft, practically places the arrangement on the same basis as that of two belts running over the same pulley, it is generally accepted that one belt will do more work than the other, no matter how favorable the conditions, or how true the pulleys. Experiments made by us in this direction has led us to conclude that running or driving the same shaft by two belts is bad business, and ought never to be encouraged, this knowledge therefore forces one to conclude that wheel B should be loose on the shaft.

There are many instances where it is necessary to transmit power long distances, for instance, a factory is situated a mile or so from a head of water or running stream, or to transmit steam power from one building to another, across a railroad or river, or other people's property, the use of shafting in either of these cases, although practicable, would incur enormous expense, so much so in fact, as to make many cases an unprofitable investment, if not impossible. In all of these cases rope transmission comes to the rescue, both in point of economy and in application. In either of these cases however, where the distance is not over 250 or 300 feet, it will be necessary to erect what is called intermediate stations, and in the use of wire rope these stations may be placed as far as 400 feet apart, where there is sufficient head room to permit of the sag of rope.

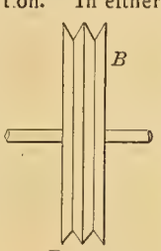


FIG. 11.

As it is only possible as previously explained, to run wire rope in cases where it is exposed to the action of the weather, we will confine our remarks to it and the use of the wheel illustrated in Fig. 1.

Wire rope is as pliable as hemp rope of the same strength, and will therefore run over the same sized wheels as the latter, though it is of special advantage to either to use wheels with as large a diameter as possible, though there is a limit to this, as the wear increases with the velocity, and it may even be found better to increase the load rather than increase the velocity.

Wire rope is made either with a wire or hemp center, the latter is more pliable than the former, and will permit of the use of smaller pulleys, and will wear better where there is short bends to be made. Where a certain amount of power is to be transmitted, say, 800 feet, and there is plenty of room to permit of the sag of the rope, it will be necessary to erect at least one intermediate station, which can be erected either of wood or masonry, according to circumstances: where however there is not sufficient room to allow of the sag of the rope, it will be necessary to take the weight of the rope upon idler wheels, the diameter of which should not be less than a third of the diameter of the driver, more especially at a high rate of speed; where the distances between centers however is short, much smaller idlers may be used with good results, though a limit will be found in a quarter the diameter of the driver.

Fig. 12

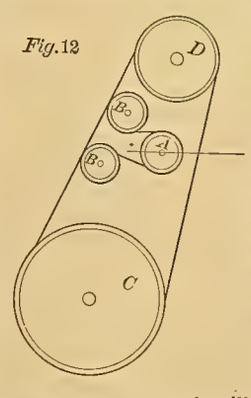


Fig. 10 shows an arrangement above referred to, in which case A and C is the driver and driven wheels, and B the intermediate station, which consists of two wheels mounted upon one shaft and keyed thereto as represented in Fig. 11. In this case it will be found good practice to make the idlers as large as the working pulleys, as they both have to perform the same amount of work as the others; where there is a limited amount of head room station B can be raised much higher than either of the other points, which may be found good practice. Where wire rope is used, it will be found necessary to use a lubricant of some kind, in which case probably the best and cheapest is a mixture of tar and linseed oil, the consistency of which should vary with the seasons, in other words, more tar and less oil in summer and the reverse in winter, as tar alone will be found to be too thick in cold weather.

Galvanized wire rope can not be recommended for the transmission of power, as the friction would soon remove the coating and the process of oxidation would go on faster than ever; steel wire rope can be recommended however for this purpose, not so much however for its tensile strength, as it is not much above iron, but for its wearing qualities, the duration of which is much beyond that of iron wire rope.

Fig. 12 represents the method of connecting an engine to the main shafting with rope in the place of leather, using one continuous length of hemp rope wound round a number of times, and finally making a turn around two idlers and a tension wheel. The driving wheel C may be any where from 8 to 16 feet or even more, and making 5 or 6 thousand feet per minute, or even more; there is but one splice in this rope and an even tension is kept on all the coils, the number of which will vary with the diameter of the wheel. The largest affair in the way of the use of hemp rope for main driving transmission, that has come under our notice, was a pair of twenty-fours by forty-eights, on one shaft (Corliss), which were turning out in the neighborhood of six hundred horse power between them; in this case however as many ropes were used as there were grooves in the wheels, which necessitated just that number of splices, and tension was kept on them by one large idler with the same number of grooves as the main pulley. This arrangement however can not be recommended as it is almost impossible to get an even tension on all of the ropes, and there is also a splice for each rope.

As will be noticed in Fig. 12, but one turn passes around the tension wheel, which controls the tension of the entire number of coils, no matter how many there may be, A being the tension wheel, will necessitate an arrangement as described in Fig. 9 and on about the same scale. The advantages of connecting up large engines in this manner can not be too highly recommended; in the first place the expense of leather is enormous, $500.00 is no unusual sum for an engine of three or four hundred horse power, and the pulleys do not have to be very far between centers at that either; in the second place the noise at high pressure is terrific, and is the worst feature about our otherwise best plants; thirdly, their weight is quite a factor; fourth, they require attention that a rope does not; fifth, it requires a man in the business to put one on right, and sometimes they don't always do it right; sixth, any deviation out of line of the shafting affects the belt, while it has no effect on a rope; seventh the rope requires less room, and will pass through a round hole little larger than its own diameter. The above points, to say nothing of the first cost, which would be about one thirtieth part of leather, are enough to banish the leather belt for main driving, into everlasting oblivion, especially in the minds of those that have had experience with large leather belts. The fact alone, that by raising the tension wheel the engine can be turned around by hand for repair or adjustment, is enough to indorse it in the minds of those who have had to do a little pulling on a fly wheel, with the entire shop hitched on. E.

A Motor's Performances.

The Baxter motor, running in the printing office of Kittredge & Friott at 74 Market street Chicago, mentioned last week, is on a loop leading from the testing room of the Chicago Arc Light & Power company; consequently there is frequently a great range in the current supplied it, and the automatic regulator is kept busy dancing across the top of the motor in a manner that would scarcely be known in a regular power circuit. The motor is speeded to 2,700 revolutions but, as reported, it has run as high as 4,500 revolutions. For testing of the capability of motor and regulator the circuit probably gives as great a range as could be desired, but the motor was placed in position to do actual work and that its performance is so satisfactory under the trying conditions speaks very well for the apparatus.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the coöperation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome, and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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National Electric Light Association.

The semi-annual convention of the National Electric Light association will be held as heretofore announced, at the Monongahela house, Pittsburgh, Pa., February 21st, 22nd, aud 23rd, the first session commencing at 11 o'clock, Tuesday morning the 21st.

The programme has already been published, and it is not necessary at this time to call attention again to the importance of attending.

Arrangements for reduced railroad fare have been made, and members attending the convention will be able to secure a rate equal to one and one-third fares for the round trip. Full fare must be paid from the starting point to Pittsburgh. The railroad agent from whom the ticket is purchased will, upon application, issue a certificate to the purchaser. This certificate must be presented to the secretary of the association, W. H. Harding, in Pittsburgh, and he will issue a certificate which will entitle the bearer to a rate of one-third the regular fare from Pittsburgh to his home.

George S. Bowen, of Elgin, Ill., the western member of the committee on transportation, has already posted notices to a number of the western members of the association notifying them of the convention, calling to their attention the facts in regard to reduced railroad fare contained in the preceding paragraph, and asking for advice in regard to intention of attending. A number of replies have been received, and the indications are that the delegation from the west will be a large one. Unfortunately, Mr. Bowen has been called east and will not return until after the convention and therefore he has asked the WESTERN ELECTRICIAN to assume the responsibility of caring for the comfort of the delegation from Chicago. All the notifications received from members intending to go have been sent to this office, and all that are received at his home before departure of the train will be forwarded to this office. Those who have not received notices from Mr. Bowen, or those whose arrangements will not permit deciding the question whether it is possible for them to attend the convention until a late date, will therefore please inform the WESTERN ELECTRICIAN.

A special car on the Pittsburgh, Fort Wayne & Chicago railroad will be set apart for the use of the delegates from Chicago, Monday, February 20th. The question whether the car will be attached to the 3:15 p.m., or 5:00 p.m. train, has been left open. The train will leave the Union depot, at Madison and Canal streets.

Delegates leaving Chicago are requested to lunch at the Chicago Electric club rooms, 122–124 Clark Street, Monday noon, February 20th, when all arrangements can be perfected.

The headquarters of the WESTERN ELECTRICIAN during the convention will be room 10, at the Monongahela house, and will be at the disposal of members of the convention.

A CORRESPONDENT takes up the subject of rope transmission of power in this issue and clearly sets forth the principles. Inasmuch as the matter is claiming attention from electric light men, especially those engaged in equipping large central stations, the article with its illustrations will be studied with interest and profit.

THE widespread and thoughtful consideration and discussion of the bill proposed by the legal committee of the National Electric Light association to revise the patent laws have shown the inexpediency of urging upon congress the passage of a bill creating a commission to make a general revision, and therefore Mr. Steuart, chairman of that committee, states that a change of plan has been made and the committee now propose to introduce a bill providing for specific changes. A convention of lawyers, principally those connected with electric light companies, as well as those interested in other branches of manufacture, will be held some time in the month of February, either at Pittsburgh or at Washington, for the purpose of fully discussing this subject.

DR. WHITEFIELD, before the Chicago Electric club Monday evening, succeeded in settling a question that has been in dispute among dentists as to the electric action of amalgam and gold fillings in the same tooth, or even in the same mouth. One doctor of dental surgery has written that "we have found that if the two metals touch in the electric battery there is no longer a current, it is dead, no shock is produced, and it is just the same when the metals are in a tooth in the presence of an acid, as it is out of the mouth, in the laboratory;" all of which was cited in proof of the theory that if amalgam and gold fillings in the same tooth, for instance, were joined, no electric action would be set up. The current would, however, still be generated and the joining of two fillings would simply amount to a short circuit. That current was generated by amalgam and gold fillings, even when they were insulated from each other when placed in water was conclusively shown by bringing a galvanometer into circuit. The point is one that may be combatted, but the evidence produced by the galvanometer can not be controverted.

THE combination of the electric light and flowers is very popular among fashionables at the present time and deservedly so, for wondrously beautiful effects can be thus produced. A very easy way of bringing about such a combination has been indicated by the electrician, who supplies the electric light in portable form in accumulators. Just now florists in response to demands for something new are vieing with each other in producing the finest effects. One florist illuminates a center-piece of flowers with small electric lights; another fashions a floral representation of a house and illuminates it inside and outside; a third fills a fire place with ferns and palms and cut flowers and brings out their beauty by electric lights interspersed. Each attempts to outdo the other in grace of design and meanwhile the storage battery, hidden away amid the flowers or in some out of the way place, is the agent that brings out the effects. The portability, cleanliness and effectiveness of the storage battery admirably fits it for a thousand uses almost unknown heretofore and it seems that there is a wide field for its application possibly never dreamed of by its designers.

COPPER still rules high, and those engaged in the electrical business are awaiting the developments of the future, buying only to meet immediate requirements. The aspect of the market abroad is set forth in the appended extract from a letter by F. R. Welles, superintendent of the Bell Telephone manufacturing company at Antwerp, who is not only a sound business man but who from his proximity to the headquarters of the French syndicate, which is engaged in carrying the copper market with the probable assistance of large copper producers in America, is qualified to write with authority:

"The syndicate evidently have the power to force the price momentarily higher than it now is, but it is doubtful if they try it, for it would cost them dear and restrict still further the consumption. Apparently they mean to hold the price at about 80 pounds per ton [equal to, say, 17 cents per pound in this country] as long a time as they can do it with success. The chances are that they will succeed in keeping the price at about that figure for some months to come, but the price must fall heavily in, say, six months."

IN the recent inaugural address of Mr. Groves, president of the London society of telegraph engineers and electricians, he presented an estimate showing approximately the industrial importance of applied electricity, as represented by the number of persons to whom it furnishes employment in Great Britain; from which it appears that there are employed in connection with British land telegraphs 23,868 persons; with submarine cable companies, mainly British, 6,000; in telephone business, 2,500; in electric lighting, 5,000 and in cable making and allied business, 5,000; a total of 42,368 persons. The percentage of each branch of business is 56.3 for land telegraphs; 14.2 for submarine; 5.9 for telephone; 11.8 for electric lighting, and 11.8 for cable making.

The total number throughout the world is estimated at 180,000 for land telegraphs, 30,000 for telephones, and 100,000 for electric lighting. Taking three as the average family of each person engaged in electric work, it is estimated that electricity, in its various applications, furnishes subsistence to about 5,000,000 persons.

This estimate includes only those engaged enclusively in electric work, besides which there are a large number of railroad employes, engineers and others, partly engaged in such work. and it is estimated that this number, added to those fully employed, would make the number in Great Britain alone, wholly and partly engaged in electric work, about 100,000, which would make the number deriving support from such work 300,000.

It is also stated incidentally, that since the establishment of the government in Great Britain, telegraphy has expanded enormously.

THE telephone trouble at Rochester, N. Y., now seems very close to settlement. In No. 3 of the current volume of the WESTERN ELECTRICIAN was published a memorandum of agreement prepared by the People's Telephone association of that city for the acceptance of the telephone company. Col. D. B. Parker as representative of the American Bell Telephone company objected to some points and accordingly the executive committee of the People's Telephone association met again on the 3rd inst., and passed the following resolutions modifying the agreement as originally published:

Resolved, "That the memorandum of the said agreement be and it is so modified that the said company be required to pay the taxable costs and reasonable counsel fees in the suits in which said company was a party, either as plaintiff or defendant, and one or more of those who were telephone subscribers November 20, 1886, were parties defendant, including the action in the name of 'The People' and the injunction action; and that the costs and counsel fees to be paid shall be only such as were reasonable in such suits;

Resolved, "That said clause [clause 8] relating to second stations and one half price therefor be stricken out, although Colonel Parker himself expressly agreed to it;

Resolved, "That the memorandum does not, and was not intended to, bind or require the company to put under ground more than three miles of the line in the principal streets as stated, and not 'every wire in the city';

Resolved, "That the said memorandum be and the same is modified in the respects as stated and set forth in these resolutions, and that in all other respects it be and remain, and that the same, together with these resolutions, constitute the complete memorandum of agreement, and that as so amended or modified it be presented to Colonel Parker for execution by or for said company;

Resolved, "That it has been the distinct understanding with Colonel Parker from the beginning that no subscriber, whether he again takes the telephone or not, shall be sued by the telephone company for rent for any unexpired term of his lease after November 20, 1886."

Chicago Electric Club.

The regular meeting of the Chicago Electric club was held last Monday evening, Vice-President Brown in the chair. Treasurer Terry presented a financial report covering the six months closing December 31, 1887. The report was satisfactory in every respect, and was ordered filed.

The membership committee reported that since the last meeting, eleven new members had been elected and six applications for membership had been filed.

Mr. Kreidler moved that the western delegates to the National Electric Light convention be invited to lunch with the club Monday noon, February 20th. Mr. Kempt reinforced the motion by moving that a committee of ten be appointed to entertain the delegates, the committee also to be the guests of the club. Both motions were carried, and the chairman appointed as such committee Messrs. Cushing, Shain, Kreidler, Terry, Haskins, Johnson, Stewart, Bailey, Horne and Buckley.

Dr. Geo. W. Whitefield was then introduced, and in an informal way described some of the applications of electricity in the dental office. The apparatus used in his demonstrations consisted of three cells of storage battery, a C. & C. motor and a rapid engine of the doctor's invention, all in circuit, and connected in the same circuit a resistance box for regulating the speed of the engine, numerous electrodes of various forms, and other minor appliances used in dental surgery.

After explaining that the galvanic current, with which he was more familiar than the faradic current, was increasing in use in dental offices, the doctor went on to show the use of the laryngoscope, which essentially consists of a small electric light, for which the current was supplied from the battery, and which is used in connection with a reflector. He showed that by the use of the laryngoscope and reflector the cavity in a tooth could be thoroughly illuminated. At this point he stopped to explain the anatomy of the tooth, saying that the tooth was composed of enamel on the outside, which is about one-sixteenth of an inch thick, then the dentine or bulk of the tooth; within that the pulp chamber which conforms nearly to the shape of the outside of the tooth, and within that the pulp which is composed of connective tissue, blood vessels and nerve filaments. He explained that the pulp of the tooth is frequently erroneously called the nerve. When the pulp is destroyed by the encroachment of decay, so that it is exposed or dies, it will, of course, become decomposed and generate a gas which irritates the tissues, resulting, when we catch cold, in irritation and a swollen face, the cause of which is often said to be an ulcerated tooth, although this is a misnomer, the proper term being an abscess. By the use of the laryngoscope the death of the tooth pulp is easily discovered by the change of color in the tooth structure. When this discoloration has progressed so far as to become unsightly, the doctor said that he could use the galvanic current for bleaching the tooth by electrolysis.

Then in way of demonstration he took a pinch of table salt, placed it in a saucer of water and introduced into the solution the positive and negative electrodes of the battery. At once the presence of chlorine gas was evident by the bubbles that rose to the surface of the water and the distinctive odor of the gas. The chemical action, he explained, was that by introducing a solution of chloride of sodium into the cavity of the tooth and applying the positive and negative electrodes of the battery chlorine gas was evolved, which united with the hydrogen of the water and set free the oxygen which is the bleaching agent.

The speaker then took up the subject of treating abscesses by the use of the galvanic current, explaining that the negative electrode was introduced into the abscess and the positive electrode frequently applied with a sponge pressed against the side of the face, and the action of current was to destroy the diseased tissue of the abscess. This same method of operation was followed, said he, in the treatment of abscesses in other parts of the body and he related an instance of a lady who had pierced the lobe of one of her ears in order that she might wear ear ornaments. It became poisoned and a large abscess was formed in the lobe of the ear. For fourteen weeks she was under treatment by a physician and was then informed the trouble in her ear was a cancerous growth. She then applied to the speaker and he followed the method outlined in the treatment of abscesses in teeth and it proved so successful that the abscess soon disappeared. The same treatment he followed in the treatment of cold sores on the lips and cankers in the mouth.

In the treatment of abscesses the doctor sometimes used both the positive and negative electrodes, in contact with the part affected, the electrodes being platinum pointed; sometimes a platinum pointed positive electrode and a sponge tipped negative electrode; sometimes he used the positive electrode in connection with the abscess and the negative electrode at some other part of the head or even the body; and sometimes he used the negative electrode in connection with the abscess and the positive electrode in another part of the head or body. The blood current, said he, is always directed towards the positive needle. Essentially the same method of operation of the treatment of abscesses is followed in the treatment of tumors or in the removal of disfiguring hairs, as on a lady's face. In the latter case the negative electrode is made to follow a hair into the follicle and the positive electrode is held in the hand, for instance; the current is turned on and the hair follicle is destroyed. That hair will never grow again but for a time the growth of adjacent latent hair follicles will be excited; but by continued treatment the removal of all the hairs is possible.

The doctor called attention to the danger of blood poisoning, saying that it had been reduced to a minimum by the use of electrolysis.

One of the first uses of the faradic current was to extract teeth. One electrode was held in the hand and the other attached to the forceps; but, he explained, that it might be that the pain resulting from the use of the current was so intense that the patient did not feel the pain resulting from the use of the forceps, as we can only receive one sensation at the same instant of time, and this undoubtedly explains the fact that patients, when teeth were extracted by the use of the faradic current disclaimed any perception of pain from the extraction of the tooth itself. Another use for the faradic current is in treatment of facial neuralgia. By stimulating the vessels of the part and bringing a fresh blood supply to the temporarily impoverished nerve tissue the pain is thus relieved. Neuralgia is often nature's call for nourishment.

The speaker also described and illustrated the use of an instrument for removing the moisture from the cavity of the root of a tooth that was about to be filled. He said that cotton was usually used to absorb the moisture in the tooth but it was not always effectual. The instrument described consists essentially of a very fine coil of wire. Through this coil is thrust a nerve broach and into the cavity of the root of the tooth. The current is then turned on and the coil being heated, in turn heats the nerve broach, which thoroughly and immediately evaporates the moisture from the root.

The electric current, he said, was also used to operate the electric mallet which consists of magnets and an armature which is the hammer.

The doctor then showed his rapid engine which consists essentially of a rapidly revolving flexible shaft connected to a motor which is in turn operated by a current from the storage battery. This revolving shaft properly inclosed within an arm which in the case shown at the meeting was attached to the side of a window frame and extended sufficiently far out into the room to give great freedom of operation on the part of the speaker. With the resistance box, operated by the foot, in circuit, the speed of the shaft could be varied from 200 to 7,000 revolutions per minute. The shaft was provided with an electrical stop which, when applied, instantly caused the motion of the shaft to cease, although the motion of the motor was not stopped. As a piece of finely wrought, delicate yet strong mechanism the apparatus excited the admiration of the spectators.

In connection with an explanation of this apparatus, the speaker described a bur that he had devised for working upon the teeth, and read from the *Dental Review* the following excerpt in regard to pain in dentistry. "Are we not as a profession to be censured for a large proportion of the pain inflicted on those who place themselves at our mercy; those who endure the excruciating tortures of having a sensitive cavity prepared with improperly formed and often dull burs, that are pressed so hard against the sensitive tissues that they grind or scrape where they should make clean, positive cuts? In this age of improvements and progress should we not turn our attention more to the mechanical construction of our instruments, and see that they are formed so as to produce the least pain in performing a given amount of work? How many stop to think when they put a bur in a hand piece, whether it is made so as to cut, not to grind out a cavity—whether it will do the work with a minimum amount of pain, or by grinding and friction inflict an amount of pain that is almost unbearable? Burs should be cut for the kind of work they are to do; for instance, in cutting enamel the axes of the blades should be parallel to the axes of the enamel rods while in the dentine. The blades cut best, as a knife would in cutting across the end of a stick inclined at an angle; the blades should be ground so as to free themselves from the chip. Also take into account the speed of your engine; the greater the speed used the fewer blades should the bur have. The higher the rate of speed at which you can run the engine and have the burs cut and free themselves, the less pain to the patient, as the pain is more or less intense in proportion to the amount of friction, and the length of time taken to perform a given amount of work. The pain caused by the bur is largely due to the heat produced, which is reduced to a minimum by a rapidly revolving bur, if the blades of the bur are properly shaped. A homely illustration of this fact can be given by holding a thin plate of steel on a grind stone, which is slowly revolved. If the stone is dry the metal will be heated according to the amount of friction given it. Now take a plate and hold it against a rapidly revolving emery wheel. The heat produced by the motion in separating the minute chip, is carried off in the chip before it has time to be imparted to the mass. This is the case in using a rapidly revolving bur in dentine; the chip is separated by a quick, light touch, before it has time to communicate the heat produced to the bulk of the tooth. This I will state as a fact, not as theory, as it is the result of my observations covering a period of years since I adopted the electric motor for my dental engine. At first it was a mystery to me why my patients complained so little about the pain produced by the electric engine."

The speaker read from the same journal the following, in regard to the rapid engine and different burs, in the report of the proceedings of the Chicago Dental society clinic: "The rapid engine with properly cut burs appears to be an obtundent. The case in the clinic was a sensitive cavity in the buccal surface of a first molar. A bur was selected about half the size of the cavity to be operated on. With one positive, firm, but light sweep of the bur, the cavity was cleaned of the decay and in an instant of time, as the engine was running at about 5,500 revolutions per minute. The patient experienced no more pain than he did in probing for the cavity with his toothpick. For hard enamel a differently cut bur is used, one with blades parallel to the enamel rods, and with a speed of from 200 to 1,000 revolutions per minute. In using polishing disks, the speed at which they work best, and produce the least friction is from 3,500 to 7,000 revolutions per minute, according to quality of the disk. When it is necessary to cut out an amalgam filling, the rapid bur will cut with astonishing ease. A large filling was removed as if it was but softened dentine."

At the close of the description and illustrations of the methods of operating the engine, the speaker demonstrated beyond question the fact that fillings of dissimilar metals in the same mouth were disadvantageous, for the reason that by chemical action an electrical current was generated, and as oxygen and acids are attracted to the negative element of a battery, that it acted upon the tissues surrounding the gold filling in the tooth, and

caused decay of that tooth. A piece of ivory was shown, upon a notch of which gold and amalgam had been placed. There was no electrical connection between the two fillings. The fillings were then connected in circuit with a galvanometer, then the piece of ivory was placed in water, and the needle of the galvanometer at once deflected, showing the generation of the current between the amalgam and the gold. The next step was to place salt in the water, and the needle deflected still more. The third step was to place the piece of ivory in the mouth, when the needle deflected still more, and as a crowning experiment the speaker inserted the piece of ivory, with its two different fillings, in the body of a cucumber pickle, in which case the needle deflected as far as its construction would permit.

A hearty vote of thanks, on motion of Mr. Haskins, was tendered the doctor for his instructive and highly interesting entertainment.

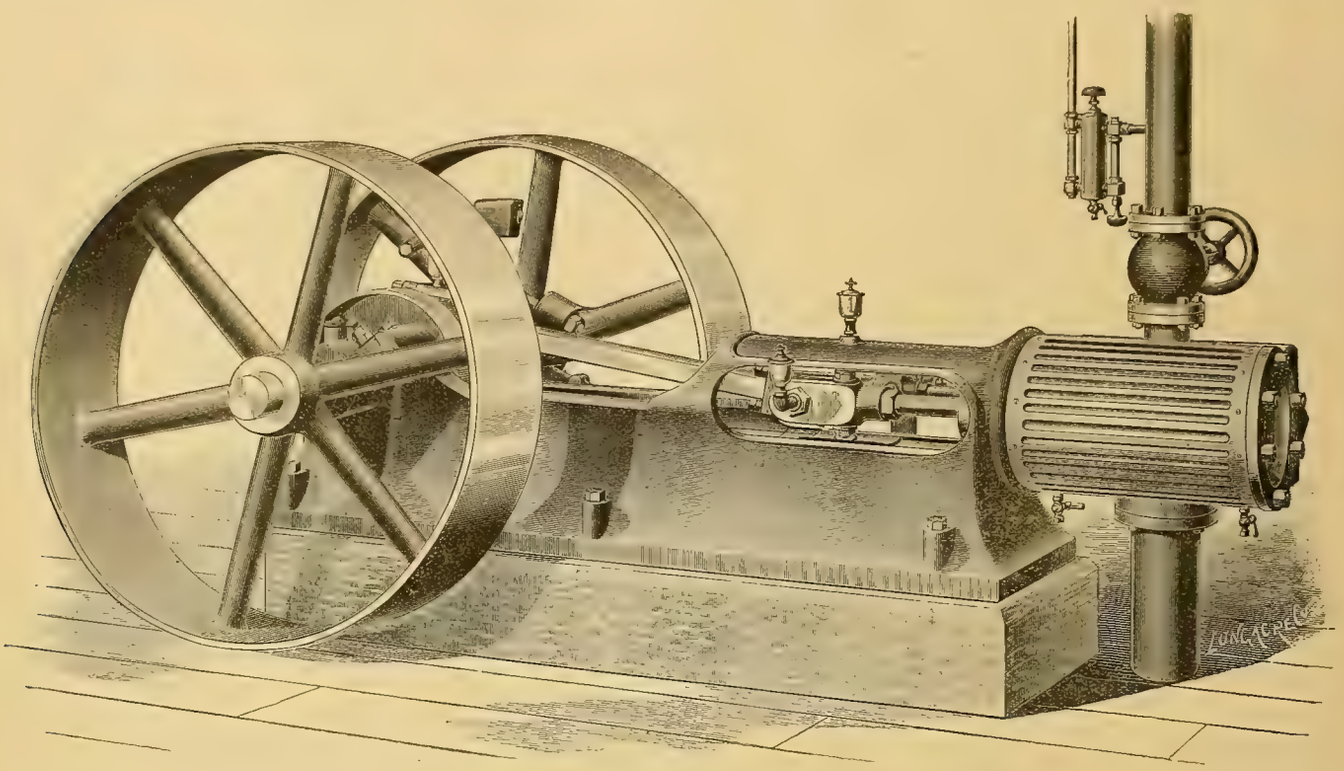

Fig. 2.

Valley Automatic Cut-off Engines.

The illustrations in connection show the Valley Automatic Cut-off engine, built by the Valley Iron works, Williamsport, Pa. These engines have been in the market only three years, during which time this company have placed and have in operation over three hundred of them. The favor with which these engines have been received, and the continuance of their success, have prompted the makers to entirely remodel their patterns and make improvements suggested by close inspection of the operation of their older engines. Fig. 1 represents the largest size center crank engine, and is representative of the 12″ x 14″, 14″ x 16″, and 16″ x 24″ engines. The engraving shows the engine with an out-board bearing and fly-wheel. The automatic governor wheel is turned crowning on the face, permitting the use of two belts, meeting cases where it is desired to belt from the engine to more than one line-shaft. It will be seen that the engine is neat in design, and so proportioned as to obtain great strength and durability. Fig. 2 represents the largest size of self-contained engines, and is representative of the 16″ x 24″, 14″ x 16″, 12″ x 14″,

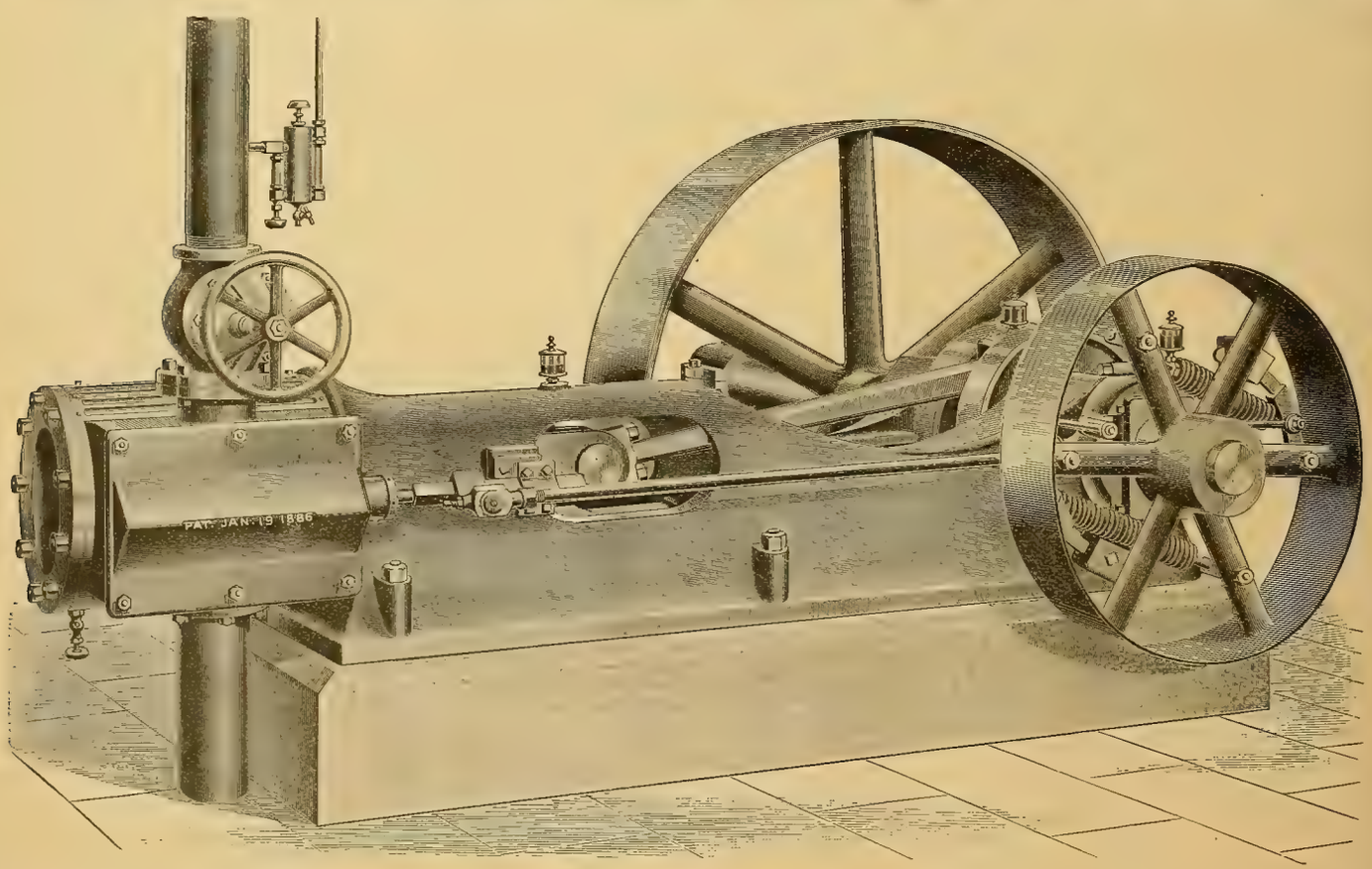

Fig. 1.

and 10″ x 12″ sizes. This style is especially designed for electric light plants—admitting of belting to two or more dynamos as the case may require. A number of these engines are employed in this branch of service, and, owing to the close regulation and economy with which they do their work, are giving excellent satisfaction. Fig. 3 represents the governor, the operation of which is as follows: the governor being of the class which draws the eccentric across the shaft, shortening the throw, and altering the travel of the valve, varies the point of cut-off to meet changes of load and steam pressure. By the mechanism employed it performs this duty and maintains a constant lead on the engine, a feature essential to a good operation.

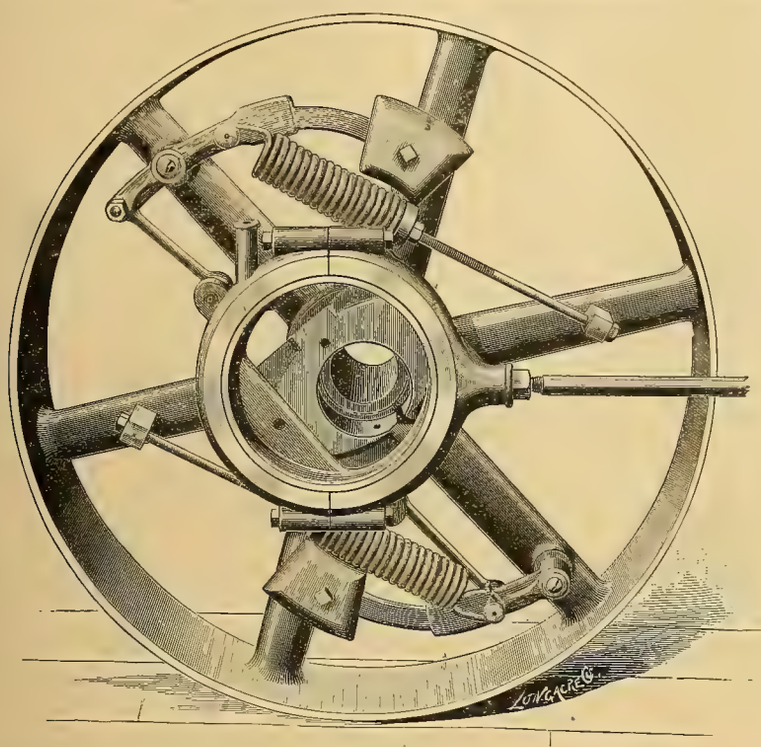

FIG. 3.

It will be seen from the engraving that the outward movements of the levers are controlled by the centrifugal force of the weights on them, and this movement is—by the link shown—conveyed to the eccentric, which slides in a sleeve next to the hub. The centripetal force is obtained by the springs shown. Close examination of this system will reveal the following: That such an adjustment of the two forces can be obtained as will admit of close regulation, such length and size of springs and such initial tension given that the increasing or diminishing force of the weight due to the distance from the center of rotation is uniform with the increasing or diminishing force of the spring due to its elongation or contraction; it will also be conceded that this construction of the governor admits of better regulation than where gravity or other constant force is employed. This governor can be reversed by turning the sleeve half round on the shaft, and pivoting levers to run the other way.

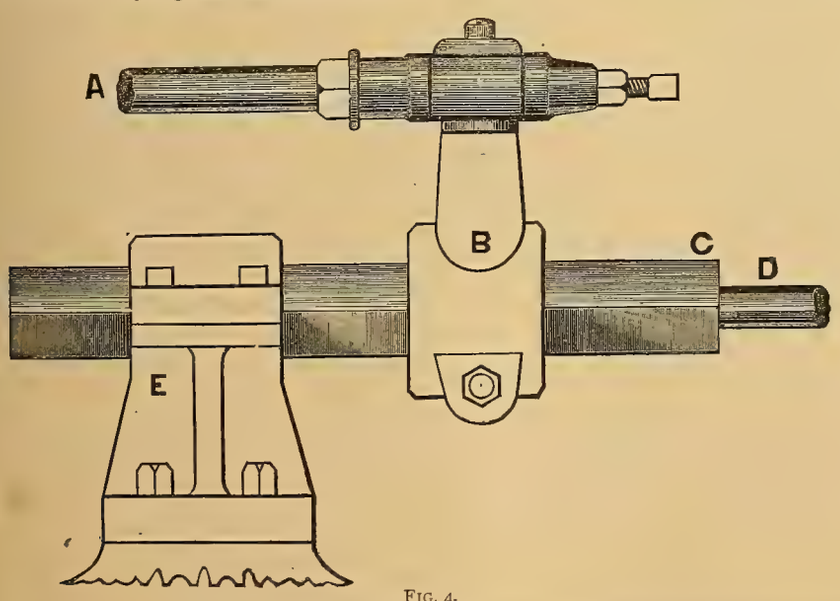

FIG. 4.

Fig. 4 represents the valve slide used on this engine. The clamp-wrist, as shown with eccentric rod attached, is pinched on the square slide with a ½″ bolt; should an accident occur by the valve becoming rusty through want of use, and stick, or strike the end of the chest, this wrist will slip, preventing serious damage. This construction of valve gear is sufficient recommendation of the slight load on, or the balancing qualities of, the valve. On the largest size engine a ¾″ valve stem is used and the slide is only 1½″ square.

Figs. 5 and 6 represent the valve. The shape of this valve is, as shown in Fig. 6, square, and set with the edge towards the center of cylinder. Over the valve is placed a cover, Fig. 5; between this cover and the seat are two strips of copper $\frac{2}{1000}$″ in thickness; these can be removed when required by the wear of the valve. By this plan it is claimed that the objections heretofore existing against the piston valve are removed, making it a piston valve without faults. When it is understood that steam is admitted in and around the valve, and the exhaust taken out at the end, it will be seen that the engine can be run with the exhaust chest cover removed, and a thorough inspection of the valve made under steam pressure with the engine running at full speed. The almost perfect balance of the valve prevents undue wear against the seat, and the large bearing surface underneath is sufficient to prevent wear due to weight. To the valve and governor of this engine, in connection with its fine workmanship, is due its success.

Figs. 7 and 8 show two indicator diagrams taken from these engines, with data as follows, viz.: Card 7 was taken from a 14″ x 16″ engine running at 240 revolutions per minute, heavily loaded. This engine is driving a woodworking establishment, and is constantly doing the work shown. The card is excellent. Card 8 is taken from a 5″ x 7″ engine at the works while on the testing block, and is a striking illustration of the quick operation of the governor. It will be noticed that there is a drop and sudden rise in the steam line; this was caused by the cut-off taking place, a sudden application of the brake affected the governor and caused the engine to take steam twice in the same stroke.

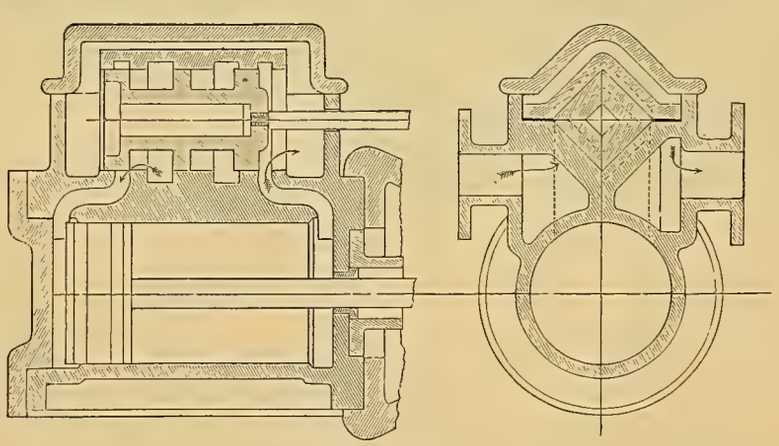

FIG. 5.

One of the best testimonials of the success of these engines is the fact that the company have in operation 22 engines in their own city.

Electricity.[1]

BY GEORGE H. BLISS.

PART I.

What is it? Where is it? Whence does it come? Whither does it go? How does it come and go? What are some of the utilities of its coming and going?

These and many other questions naturally suggest themselves in taking up this theme for consideration.

It is a broad subject, and in the brief time I intend to occupy it will be possible to consider only a few of the characteristics of this subtle force which we call by the name of electricity.

In a conversation not long since, Mr. Edison remarked that "owing to the increasing magnitude of the electric field, the only hope for one

1 Read before the Hyde Park Lyceum, Feb. 6, 1888.

who desires to attain eminence therein is to confine himself to a specialty in electric investigation or application." Mr. Edison has probably covered a wider range, both in the number and variety of his inventions pertaining to the electric arts, than any man, living or dead. After years of application, to which he has brought the highest genius and the most intense industry, he finds, as do all others who delve in the realm of knowledge, that the horizon of his understanding constantly broadens, till it becomes too vast for general research, and effort must be confined to a special line of thought, to reach practical results.

There are a few units which have been adopted for use in electrical measurements. Crudely stated, the ampere represents the volume of electricity; the volt expresses the pressure, and the ohm stands for the resistance encountered.

An amateur once asked Mr. Edison what the terms, ohm, volt and ampere really meant? In a somewhat humorous vein he replied; "They are scientific terms invented for the purpose of concealing what we don't know."

There was a good deal of frank truth in this reply, for what we "don't know," about electricity far exceeds the exact knowledge attained, and indeed we are now only upon the borders of a vast realm of possibilities pertaining to it. It might be easy for me to mystify many of you by an array of electrical terminology, but such is not my purpose. It is my choice to say to you frankly at the start "that I don't know," and to indulge in the desire that what is said may serve the simple purpose of interesting and stimulating you to find out for yourselves.

Almost in the opening sentence of this paper I referred to electricity as a "force." It is closely allied to heat and light, being easily convertable to or from either by motion. An illustration of the interchangeability of forces, is shown in the ordinary means employed for producing the electric light by dynamic electricity.

The latent store of energy is first found in the coal which is called into activity by combustion, in the form of heat. The heat applied under the boiler converts the water into steam; the steam sets the engine in motion which in turn rotates the armature of the dynamos. This operation converts the force applied into electricity. The electricity is conducted over suitable wires to the lamps where it changes into light.

In explaining this transformation of energy at the railway exposition which was held in this city a few years since to the Rev. H. M. Scudder, who was always intensely interested in mechanical and scientific results, after having had the various steps traced, he finally inquired: "How is it that in the dynamo machine motion is converted into electricity?" I could only answer that by constructing the machine with certain proportions and applying motion to the armature electricity is produced.

"Oh," said he, "then the system is built upon a discovered fact." I desire to call the attention especially of the young, to the importance of an established fact. Whenever a fact presents itself clearly to your comprehension cling to it with pertinacity. Don't allow yourself to be reasoned or shaken away from it by sophistry or false logic. He who is so fortunate as to give to his generation a new and indisputable fact accomplishes far more than many of us can reasonably expect to add to the world's knowledge. As years creep upon us we are sometimes startled by the ease with which young men grasp subjects under which it was our lot to stagger with much difficulty. We are apt to forget that they come into the arena having the full benefit of all the accumulated facts which readily enable them to mount to an altitude of comprehension to which we climbed, if at all, with the utmost difficulty. It is customary to speak of electricity as a fluid and many of the terms necessarily used in explaining its phenomena are based upon this theory.

We are also often told that electricity pervades all matter, that some substances have the capacity for storing a large amount of electricity while others will hold much less in comparison. When a body contains an excess of its normal charge it is said to be in a plus condition and when there is a deficiency it is in a minus condition. When there is a plus condition the tendency is to discharge to surrounding bodies and when there is a minus condition the tendency is to draw from surrounding objects. Again, it is sometimes said there are two kinds of electricity, the one positive and the other negative. Bodies charged with the same kind of electricity repel each other. Bodies charged with opposite kinds of electricity attract each other, but as soon as contact is permitted, if the charges are proportionate, they immediately neutralize each other. The earth is generally considered as a great reservoir of electricity and we know that as a mass it has a fixed polarity attracting the compass north and south. We know that a piece of iron placed north and south on the surface of the earth, if allowed to remain, will become polarized, indicating electric currents and action. We know that rocks are often filled with metals in such a way as to be almost positive proof that the deposits were made by electric action.

In the winter the aurora borealis often brilliantly illuminates the northern sky. In the summer the lightning's flash repeatedly reminds us of the presence and energy of electricity. So nature seems at times to flash upon our senses of touch, sound and sight, the consciousness that electricity is all pervasive and ever ready to manifest itself by the most brilliant display of illumination and power.

Let us look more carefully into the known causes which bring electricity into action. If I rub this glass tube with the silk handkerchief held in my hand electric force will be excited on the surface of the glass. This is shown to you by the fact that when I hold the tube over the bits of paper on the desk they are attracted to it. Now, what is the explanation of the presence of this electric force upon the tube? It is simply that the mechanical energy in the form of motion which was applied to the tube has been converted into electricity. A small portion of the energy has been turned into heat and the balance has been converted into its electric equivalent. Of one thing we may rest assured, that as you can not destroy a particle of matter but only change it from one form to another, so no portion of the mechanical force expended upon the glass is lost, but it exists as heat, electricity or stored force ready to exert itself when conditions are favorable.

(To be continued.)

Among recently incorporated companies is the Chicago Automatic Induction company; capital stock, $1,000,000; incorporators, George S. Robertson, James C. Martin and M. H. Tilden.

Thomson-Houston in the Pennsylvania Depot.

The Pennsylvania Railroad company never goes into anything by halves nor takes up a matter without careful consideration. This well managed corporation has for a long time been considering the matter of electric lights and how best to utilize them.

After looking at the matter from all sides they came to the conclusion that it was the best economy and the most satisfactory in every way for the road to own its own plants. Having decided in favor of the electric light and having concluded that the best policy was for the railroad corporation to own its own plants in all its principal stations between Chicago and the seaboard, the next question was the adoption of a system and the Pennsylvania depot in Chicago was selected as the initial point to put the company's policy as regards electric lights into operation. With so much at stake and so many plants depending perhaps upon the selection made for the Chicago depot, the competition for this initial installation was of course very keen. The Thomson-Houston company however carried off the contract and the plant is now installed and in full operation. A brief mention of this fact was made in last week's WESTERN ELECTRICIAN.

The Thomson-Houston installation at the Pennsylvania depot is a model one in every way. The engine and dynamo room is located between two abutments of the viaduct over which Adams street passes, or in other words, the room is directly beneath the surface of Adams street, nevertheless the space has been utilized to the best advantage and a clean, neat and compact dynamo room is the result.

There are four dynamos, two arc and two incandescent, the former being twenty-five and thirty-five light capacity each respectively and the latter 350 lights each. At present, however, 68 arc lights and 860 incandescent lamps are burning. The dynamos are at one end of the room and the engines are at the other. About midway between dynamos and engines is the shaft, it is provided with friction clutches so arranged that any one or all the dynamos can be run from it. The power consists of two automatic cut-off engines each 12"x12" and at present they are running at 265 revolutions and give the shaft a speed of 417 revolutions. Steam is supplied from a battery of internally fired boilers, located in the basement of the building on the opposite side of the passage way leading to the dynamo room.

There are five arc circuits and nine incandescent circuits, which, by the way, are of okonite wire throughout, a wire of first class insulation being necessitated by the character of the building into the construction of which iron enters largely. The switch-board is very complete, while the equipment of current indicators and voltmeter, the arrangement of fusible strips and switches and wall controllers for equalizing the current in the arc circuits leaves nothing to be desired.

The arc lights are mainly distributed throughout the train shed and outside the building, while the incandescent lights are used in the waiting rooms and the various offices in the station. The entire system is in operation from about half past four o'clock in the afternoon until half past eleven o'clock at night. Then a part of the arc circuit is cut off and the remainder run until three o'clock in the morning when more arc

FIG. 7.

FIG. 6.

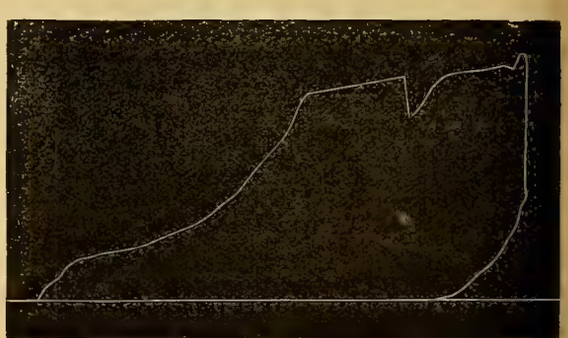

FIG. 8.

VALLEY AUTOMATIC CUT-OFF ENGINES.

lights are cut off, while the main part of the incandescent lights are used until about midnight. The electroliers are handsome and the light perfectly satisfactory. As a whole the plant is a splendid one and has been constructed with that care for detail that is a marked characteristic of the Thomson-Houston company. The Pennsylvania company is highly pleased with the installation.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 4.—The notable event in electrical circles this week was the formal opening Tuesday evening of the permanent home of the New York Electric club. The four story building at 17 East Twenty-second street was purchased by the club some months ago, and it has been fitted up by friends with such electrical and other furniture and novelties, that there is not another among the many club houses in New York that will compare with it in general attractiveness. The house-warming was opened by a short address by the president of the club, Henry C. Davis, who introduced the orater of the evening Prof. H. A. Rowland, of Johns Hopkins university. Prof. Rowland spoke of the "Electrical and magnetic discoveries of Faraday," and his address was followed by happy remarks by Mayor Hewitt, Dr. Geo. H. Benjamin, Dr. Otto A. Moses, O. E. Madden and others. About four hundred members of the club and guests were present, and letters of regret were read from President Cleveland, Governor Hill, General Sherman, Admiral Porter, Prof. C. A. Young, and many other distinguished gentlemen. One of the most pleasant incidents of the evening was the presentation to President Davis of an elegant Geneva non-magnetic watch. Of course the building is brilliantly lighted both inside and outside, no gas being used, however, and it is fitted up with the common electrical appliances, such as bells, annunciators, etc., but there are some novelties which attract the attention of each visitor. One of the most pleasant surprises is at the threshold, for the door is opened automatically as one puts his foot on the topmost step of the stoop. The boot-blacking apparatus is fully appreciated; a porter daubs blacking on a man's shoes and then puts on the polish by means of a brush that is rapidly revolved by an electric motor. Steaks are cooked on an electric broiler, and feet are warmed on an electric heater. Self-winding clocks, that will run for a year without attention, are operated by storage batteries. The safe is protected by an electric combination lock. The Metropolitan and American companies have placed their telephone instruments in the building, so that communication may be had direct with all subscribers in New York, Philadelphia, Boston, Albany, New Haven, and other points. The club house and its many attractive features must be seen to be fully appreciated, and a cordial invitation to call is extended to all persons interested in electrical matters.

The confidence of Northern capitalists in the "new south" and the application of the electric motor to the operation of street railways, is shown by the building and equipment of the new Union street railway at Richmond, Va., by a New York syndicate. This road was completed and put into successful operation last Monday, and as the cars are driven only by electric motors, some details of the system may be of general interest. The Sprague overhead contact system is used. There are about thirteen miles of track, with forty cars, running at a maximum speed of fifteen miles an hour, the axles of each car being moved by two motors, having a total capacity of fifteen horse power. The power is supplied from a central station, by three Armington & Sims engines, each developing, when running at full speed, 125 horse power, and driving two Edison dynamos especially wound for this service. The feed wires tap into the line wire at four different points, thus maintaining the pressure approximately equal all along the line. All the conditions and difficulties of street railway service have been successfully met in the case of this new road at Richmond, there being an unusual number of grades and curves, the grades reaching a maximum of twelve per cent, and most of the time when trial trips were made the rails were covered with sleet and snow. It is by far the largest electric railroad equipment in the world, and is larger than all the electric railroads of Europe put together.

The report of the board of trustees of the American institute, which was read and adopted Tuesday of this week, stated that scientifically the recent electrical exhibition was the most valuable ever held under the direction of the nstitute.

Complaints have been made by the Western Union Telegraph company, as well as by many victims, about the swindling operations of a telegraph school on East Fourteenth street, called the Western Telegraph company, which advertises to teach young men and women telegraphy for a large money consideration in advance, and then get them permanent situations at from $75 to $100 per month. These complaints have reached good Mayor Hewitt's ears and excited his sympathy, and he, in a letter to President French, of the police department, proposes action as follows: "I can not find any means of reaching them through the law. It seems to me therefore that it will be necessary to station a police officer in front of the premises, and warn all young men and young women who are seen going in and out of the institution, of the character of the place, as was done in the case of mock auctions. This may lead to a suit for damages, but, as I am determined to break up this institution, I will be personally responsible for the consequences. I trust that you will take immediate action in the matter, as I have now a list of ten young men and young women who have been swindled out of their money in this place."

Partrick & Carter, of Philadelphia, have issued a new illustrated catalogue. Particular attention is called to two new electrical devices, which are fully illustrated and described, namely, a patented combination bell and push button, the complete instrument being smaller than an ordinary box bell; and a new hotel annunciator, with guest time call, room call and fire alarm combined.

P. T. Barnum has his offices in New York and at winter quarters of his show at Bridgeport connected by a telephone line with long distance instruments. It was said that while the recent poultry show was in progress, the roosters raised such a racket that it was almost impossible for the New York clerks to hear at their end of the line, and that the screech of the biggest Shanghai in the show was plainly distinguishable.

Pilots have never taken kindly to the illumination of water by electric lights. The lights on the tower at Hell Gate were discarded some time ago, and this week Alderman Holland presented to the board of aldermen a petition from the American brotherhood of steamboat pilots, seting forth that they are suffering from the electric lights on the river fronts because the glare and reflection of these lights bewilder them in the wheelhouse, and thus endanger the lives of thousands under their charge. They asked that the lights be masked upon the side next to the water.

Chas. A. Schieren & Co., report sales of leather link belting this week to the following electric light companies, for use with dynamas: Fort Wayne Jenney Electric company, Edison Electric Illuminating company, Brockton, Mass., Plainfield Electric Light company, Edison Electric Illuminating company, Birmingham, Ala. A.

From Kansas City.

KANSAS CITY, MO., Feb. 4.—Among the electrically equipped and burglar proof residences of this city the palatial home of J. C. Dold at 1220 Troost avenue, stands at the head. All the doors and windows are connected with an electric alarm, while floor matting is placed at each door, at the head of the stairs and in front of the safe and side-board. In the circuit is an alarm bell located in Mr. Dold's sleeping apartments. Electric automatic gas burners are attached to each chandelier so that by the pressure of a button in Mr. Dold's room, the house can be lighted from cellar to garret simultaneously. If an intruder should overcome the burglar alarm on the doors or windows he would be sure to encounter the floor matting and thereby give warning of his presence. A C. and C. electric motor also adorns the house, making itself useful as well as ornamental. Last but not least is the large full-blooded mastiff that roams the house nightly at his pleasure. It is evident from the foregoing that Mr. Dold and family are well protected from the criminal class that have infested the city lately.

The Interstate Electric company have just finished placing a large Hess annunciator with return call and fire alarm connection in the Bonaventure hotel on Independence avenue. The annunciator gives splendid satisfaction and much credit is due O. W. Detsch, the company's electrician.

The same company have also just finished putting 66 cells of the New York Electric Accumulator company's storage batteries in Whittick & Penfield's paper house 517 Delaware avenue. The current is generated by a Hawkeye machine. The firm intends to light stores and offices in the vicinity and will increase their plant as the demand grows.

Articles of incorporation of the Home Telegraph company have been filed in the office of Recorder Hinde. The capital stock is $100,000, divided in 1,000 shares of par value of $100 each. The stockholders are all residents of Kansas City and their names follow: Thos. E. Gaines, Chas. E. Kearney, P. H. Madden, F. P. Perrin, John Speas. The purpose of the corporation is to construct and acquire by lease or otherwise, and to operate telephones and telegraph lines; also to operate and lease a system of communication by messengers and to convey messages and signals.

Rumor had it that the Missouri & Kansas Telephone company would remove their general offices now located here to Topeka, but the treasurer informed your correspondent that they would remain in Kansas City.

A new American District Telegraph company was formed here on the 4th inst., capital fully paid up. The following is a list of the officers and directors: President, C. B. Adams, vice-president, Rollin Bingham, treasurer, American National Bank; secretary and general manager, Coles Flournoy; directors: C. B. Adams, Rollin Bingham, Coles Flournoy, C. H. Cone, J. P. Gilmer; attorney, Wm. Allbritian. The E. P Supply company's automatic district system and appliances will be used.

The Fort Wayne Jenney Electric Light company have placed in Swift & Co.'s packing house in Armourdale, Kansas, two incandescent and one arc machine. They are now running 525 incandescent and 16 arc lights. The plant will soon be increased. Kerite and okonite wire are used throughout.

The Interstate Electric company of this city, have placed 66 cells of the New York Accumulator Co.'s storage batteries in the new office building of the Wabash railroad. A Thomson-Houston dynamo is used in generating current. The company contemplate putting in a new dynamo in the near future.

The city of Chetopee, in the southeastern part of Kansas, has probably one of the finest equipped electric light plants in the west. The construction work was under the supervision of C. A. E. Rueble. They have two 450 light Edison dynamos, of the latest pattern, one Buckeye engine of 100 horse power, also a Buckeye boiler of the same capacity. They are now running upwards of 600 incandescent lights, which are located in churches, stores and hotels. At a recent meeting of the council of that city, a contract was made for five arc lights, which will be running within a week from date; the lamps to be used are the Simplex, which are run from the Edison circuit. This is no doubt the only plant in the west running arc lights from an incandescent circuit. The plant is owned by R. B. White, J. J. Flannery, and Thomas O'Hare, all leading merchants of the city. They are contemplating placing about eight arc lights for the stock yards and railroads.

H. G. Smiley, manager of the Electrical Protective Supply company, is here on business for his company.

C. H. Cone has just returned from a short trip through Kansas, in the interest of the Electrical Supply company.

Among the recent arrivals in our city, is D. H. Dorsett, of Chicago, proprietor and contractor for the Dorsett conduit system of underground

wires. Mr. Dorsett's intention is to ask the city for a franchise giving him the exclusive right to lay conduits for telegraph, telephone and electric light wires in Kansas City, for a term of years.

Oswego, Kansas, is soon to have an electric light plant. The station is nearly completed. The system has not as yet been decided on.

Among the large isolated electric light plants of this city, the United States Electric Lighting company's plant in the Nelson & Welles building, corner of Missouri avenue and Main street stands at the head, being one of the most complete and largest plants in the city. The building is one of many beautiful ones and is six stories high. The first story of the outside wall is built of Bedford oolitic limestone and Warrensburg sandstone ornamented with large polished columns of Jonesboro red granite, the remaining five stories are composed of Fox Island gray granite, also ornamented with smaller columns of Jonesboro red granite which lends a peculiar contrast, adding greatly to the beautiful and massive appearance of the structure. Three pediments rise above the cornice to the dizzy height of 115 feet from the curbing. The building contains 182 elegantly fitted offices, eight store rooms and basement. The upper floors are occupied exclusively as offices, including the city offices, eleven in number. The interior decorations are very elaborate; the walls and ceilings are of hard finish, with wainscoatings composed of varnished Lincrusta Walton trimmings in panels. The rooms are provided with massive brass chandeliers, which furnish incandescent electric lights. The hall floors are of colored tile. Each floor is provided with spacious wash rooms and closets. The building is provided, as generally expressed, "with all modern improvements." In the basement fronting on Missouri avenue, is located the electric light plant, consisting of a 150 horse power Ide engine, which furnishes power to four United States electric light dynamos, three incandescent, with capacity of 300 lights each, and one arc; 1,000 incandescent and twenty arc lights are used in the illumination of the building. From the following it will be seen that the engine room is the acme of perfection: It is 90 by 20 feet in dimensions, and is finished in California red wood, with colored tile flooring. The switch-board is made of California red wood, paneled and carved. United States fittings are used throughout. The lights on the floors and in corridors are so arranged that they can be controlled from the switch-board. Two duplex compound pumps furnish water for the elevators. The dynamos are so arranged that they can be cut in or out at pleasure without stopping the engine. Six boilers, of 100 horse power each, furnish power for the electric light engine and for heating the building. The plant is perfect in every detail, and gives entire satisfaction. Much credit is due Wm. Sex, the genial electrician, for the perfect satisfaction the plant has given. It has been running eight months, and in that time has burned out but ninety-two incandescent lamps. D.

A Detroit Note.

DETROIT, Feb. 4.—The product of copper from the Lake Superior mines for the month of January was as follows: Calumet & Hecla, 802 tons, Tamarack, 625; Atlantic, 228½; Osceola, 210; Franklin, 177; Huron, 110. C.

THE ELECTRIC LIGHT.

The palatial stables of LeRoy Payne at Chebanse, Ill., are lighted throughout by the electric light.

The electric light plants in Monmouth and Champaign, Ill., were started on the first.

THE ELECTRIC MOTOR.

An electric tram-car has been shipped from Wolverhampton, England, to Sydney, New South Wales.

THE TELEPHONE.

It is said that the German government is disposed to relax the strictness of its recent interdiction of telephonic communication across the French and Swiss frontiers, and to sanction a project for a line between Brussels and Cologne, and that the work will soon be commenced.

THE TELEGRAPH.

The Postal Telegraph company, of Chicago, has taken the street floor in the Phœnix Building, and will have their local general offices there. This is one of the finest offices in the Board of Trade district.

Frank J. Primrose, of Philadelphia, has sued the Western Union for $50,000 damages. He claims to have lost that sum through a blunder in sending a telegraph message, by which his western agent bought wool on a falling market.

Miscellaneous Note.

The Western Electric Benevolent association gave a most enjoyable masquerade ball at Klare's hall in Chicago February 3rd.

Electrical Patents.

Issued Jan. 31, 1888.

377,021. Electric Temperature Regulator. Lucien F. Easton, La Crosse, Wis.

377,046. Armature for Dynamo Electric Machines. Edward J. O'Beirne, Elgin, Ill.

377,073. Protecting Device for Electrical Apparatus. Angus S. Hibbard, New York, N. Y.

377,083. Electrical Auxiliary Signalling System. Geo. F. Milliken, Boston, Mass., and Henry B. Lytle, Providence, R. I.

377,107. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The invention relates to supporting and changing storage batteries on street cars, etc We give the first of the nine claims: "The combination of a car having compartments under the seats, a removable bottom for said compartments, and secondary batteries supported upon said removable bottom."

377,110. Telegraph Instrument. William S. Logue, Baltimore, Md.

377,118. Insulating Electric Conductors. Rupert Schefbauer, Dresden, Saxony, Germany.

The invention consists in passing the conductors between rollers along with a sheet of paper moistened with a solution of ammoniacal oxide of copper, and afterward treating the said sheet by heat and pressure.

377,210. Electrolyte Compound. George B. Pennock, Brooklyn, N. Y.

The first of the four claims is given: "In an electrical battery, mineral wool, in combination with acids or fluids of any kind capable of decomposing it."

377,215. Traveling Current Collector for Electric Railway Motor-Cars. William M. Schlesinger, Philadelphia, Pa.

Of the twenty-seven claims we give the first and the last: "1. In an electric railway, the combination, with a car, of a bar or support and a current-collector frame mounted upon said support and having a longitudinal and a lateral rocking motion, a lateral sliding motion, and a vertical movement independently of said support, substantially as and for the purpose set forth.

"27. A traveling current collector for electric railway cars, composed of a central plate, provided with separate side plates, and integral side lugs, said side plates being secured to plate and inclosing conductors, and insulated brushes, secured to lugs and in circuit with said conductors, substantially as set forth."

377,217. Alternating Current Motive and Regulating Device. Elihu Thomson, Lynn, Mass.

The third claim is as follows: "A motive or regulating device for alternating current circuits consisting, essentially, of one or more alternating current coils, a closed circuit conductor adapted to carry induced currents of high self-induction, and an iron core connected to said conductor and movable with the same into different positions in the magnetic field, as and for the purpose described.

377,218. Electric Belt. George W. Totman and Perry C. Totman, Cassadaga, N. Y.

377,229. Electric Locomotive. Edward M. Bentley, New York, N. Y.

The invention is stated to consist in gearing the motor to a single axle, while at the same time it is supported on a framing outside the axle, so that its whole weight rests on the axle, and thereby increasing the tractive power of the vehicle

377,230. Electric Motor. Edward M. Bentley, New York, N. Y.

377,237. Plug Switch for Telephone and Telegraph Circuits. George H. Cole, Atlanta, Ga.

377,255. Regulation of Electric Motors. Daniel Higham, Philadelphia, Pa.

The invention relates to constant current motors, and its object is to regulate the speed of such motors. We give the last claim: "The combination of the armature of an electric motor with a field magnet having shunt coils and series coils opposed to each other, a short circuit around the series coils, a movable contact to open and close said short circuit, and a speed-governor driven by the armature to operate the said contact."

377,256. Electric Annunciator. John W. Hoffman, Pullman, Ill.

377,319. Electric Motor. Charles T. Mason, sr., Sumter, S. C.

377,340. Galvanic Battery. David Urquhart, Westminster, and Benjamin Nicholson, South Norwood Park, County of Surrey, Eng.

The first claim is: "An electric battery having a negative element composed of or carrying peroxide of silver, in combination with a positive element and electrolyte, substantially as described."

377,344. Railway Telegraph. Charles W. Williams, Cave City, Ky.

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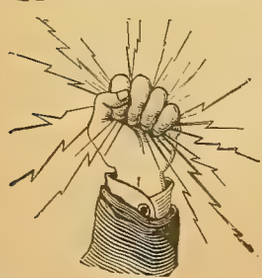

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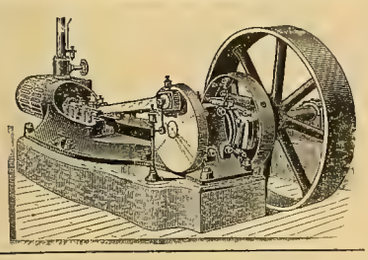

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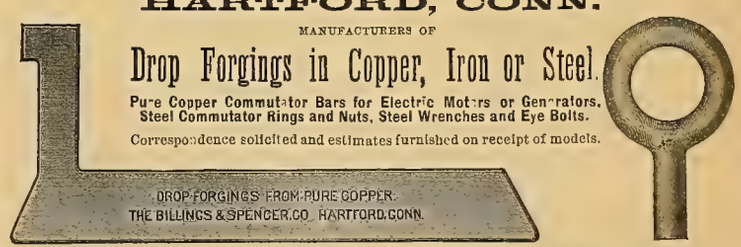

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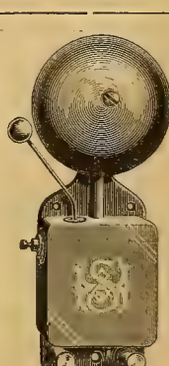

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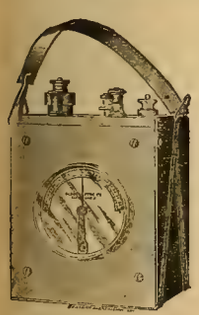

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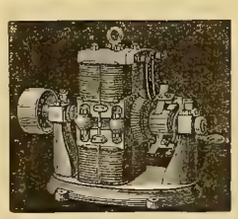

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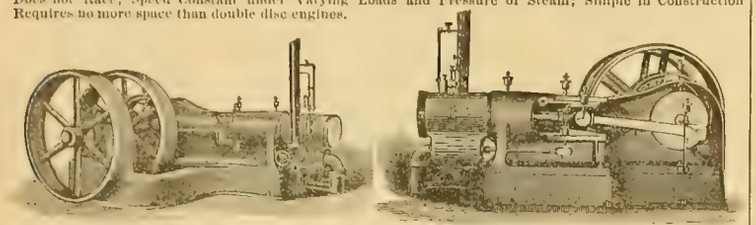

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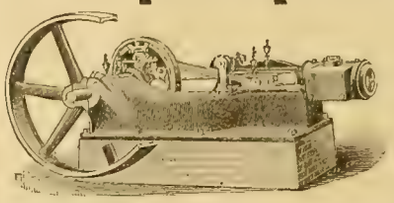

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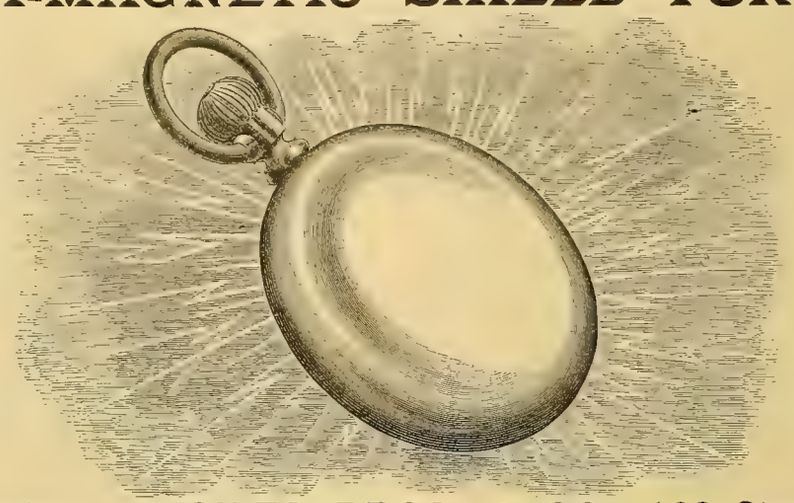

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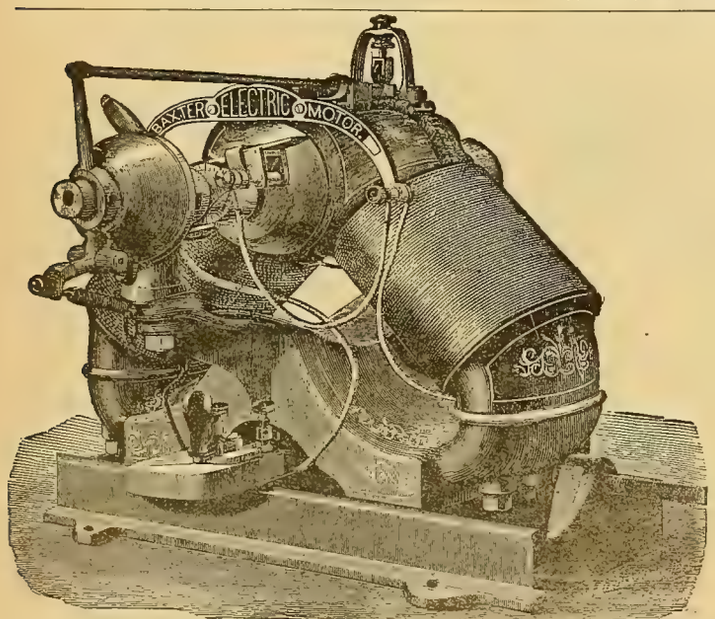

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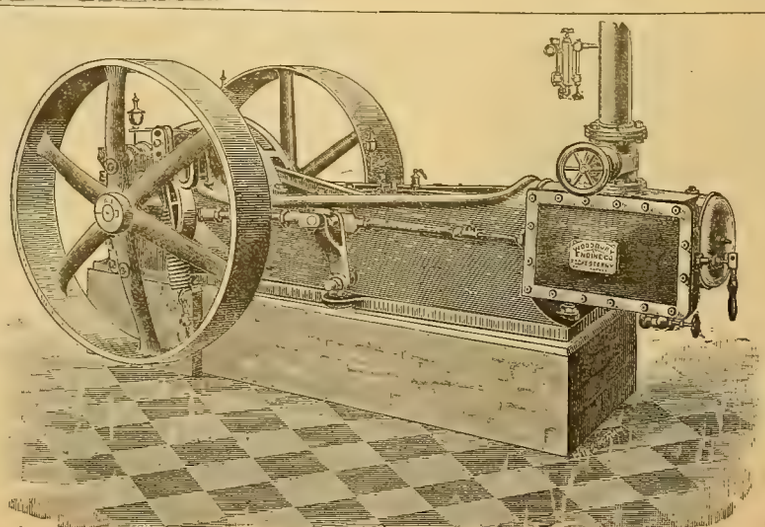

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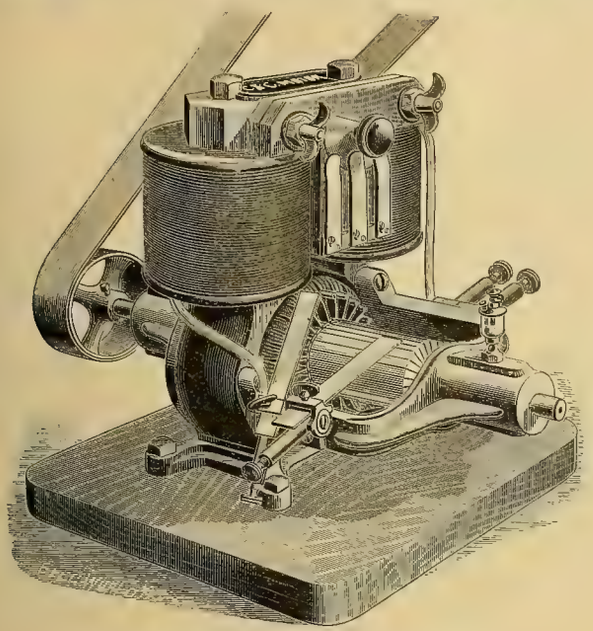

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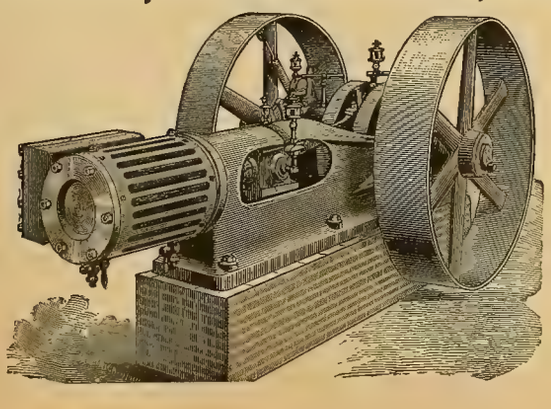

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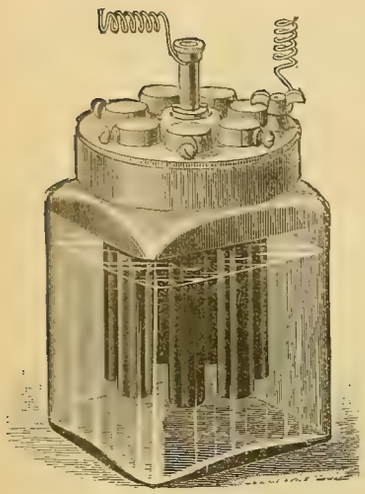

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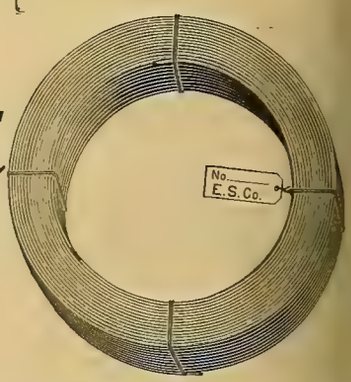

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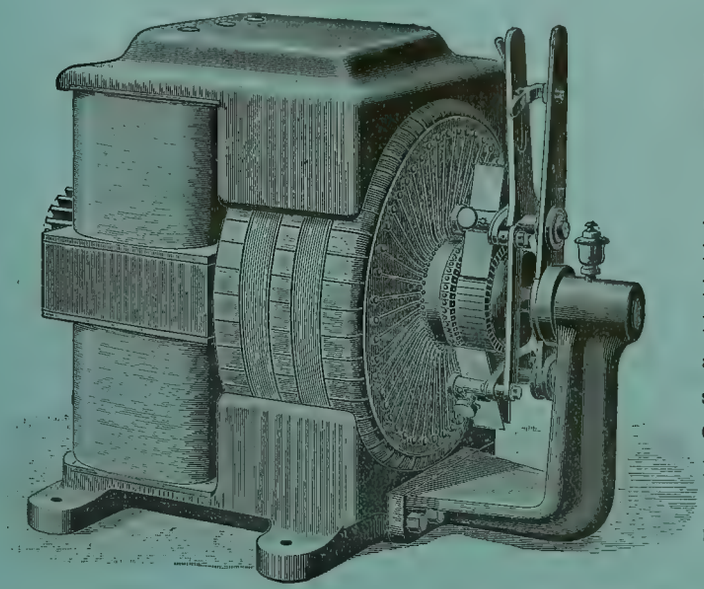

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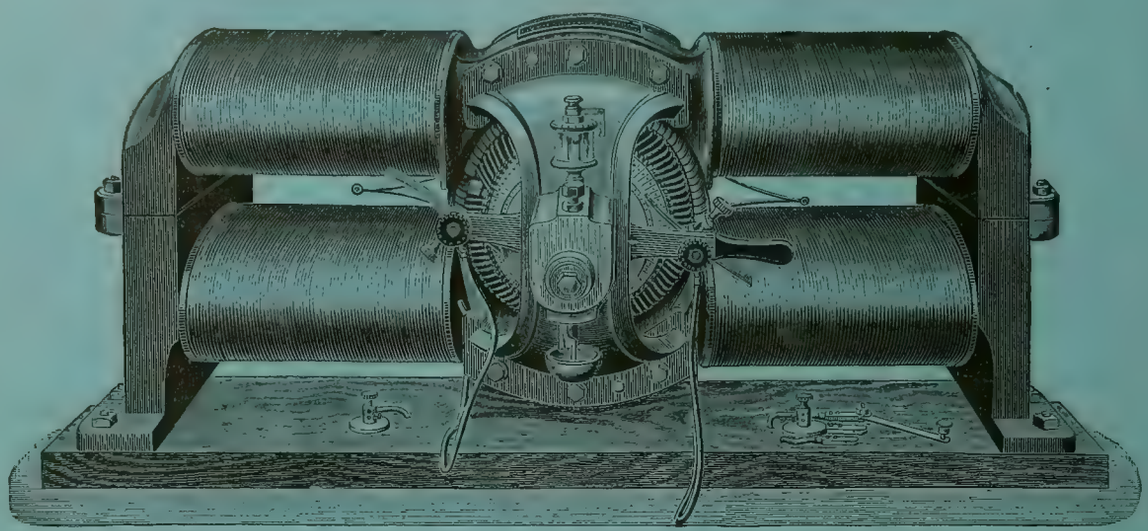

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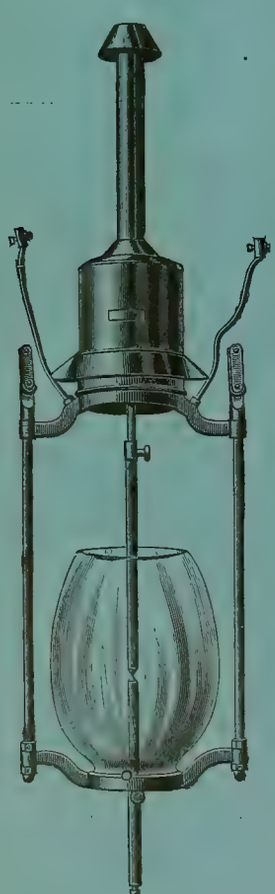

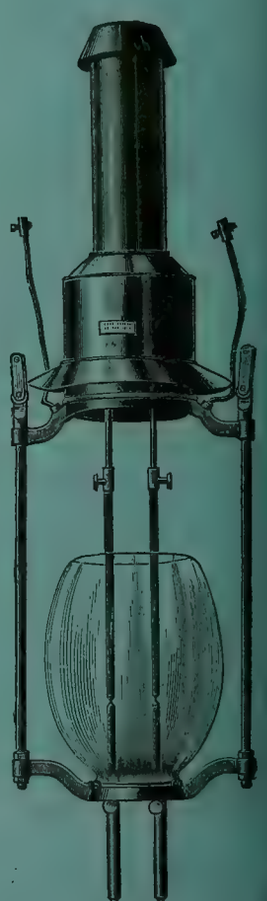

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At the Great Southern Exposition at Louisville, 1883, for Best Arc System. Awarded First Medals for Best Arc Lamp, Best Arc Dynamo, Best Arc System.

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—ALSO—

COMPLETE INCANDESCENT SYSTEM.

DYNAMO: PERFECTLY AUTOMATIC, SHUNT WOUND, REQUIRING NO RESISTANCE for variable load.

LAMP: NEW FILAMENT, NEW PRINCIPLE of Construction, REMARKABLE LENGTH OF LIFE with FULL CANDLE POWER, will not deposit carbon on inner surface of bulb.

The filament is as pliable as a piece of thread and is not made brittle by the action of the current.

Complete System of Fixtures and Attachments, also full line of Electroliers, Combination Fixtures and Shades.

We are in the market for Large Incandescent Contracts.

ELECTRIC MOTORS

We have the Only Perfect Working Headlight for Steamboats, with Focusing Reflector. Full information furnished on application.

Western Electrician.

EVERY SATURDAY.

Vol. II. CHICAGO, FEBRUARY 18, 1888. No. 7.

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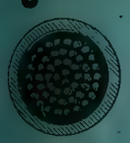
Standard Underground Cable Company,



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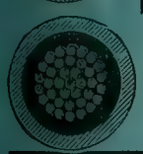
Branch Offices: { New York, Telephone Building, Cortlandt Street, G. L. Wiley Manager. Chicago, 139 East Madison Street, F. E. Degenhardt, Manager.

MANUFACTURERS OF

The Waring Anti-Induction Bunched Cables



For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial.

LIGHT LEADED CABLES FOR HOUSE USE.

Insulated Line Wire, Underwriters', Magnet, Annunciator and Office Wire,

Five Years of Uniform Success Enable us to Guarantee our Cables.

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—MANUFACTURERS OF—

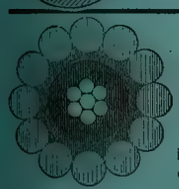
BITITE and TRINIDAD

INSULATED WIRES AND CABLES.

Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

TRINIDAD WIRES for Line Work in place of Underwriters.

ELECTRIC LIGHT WIRES of all sizes a SPECIALTY.



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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power. Telegraph and Telephone, Railway and all other Branches of Signaling.

All Sizes *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

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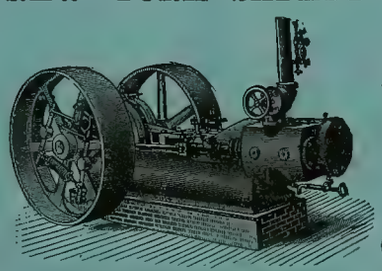

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Automatic Cut-Off Engines,

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And other duty requiring close regulation of speed.

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AMERICAN Leather Link Belt Co.

A NEW BELT

Especially adapted for use with Dynamos.

Write for particulars and prices to

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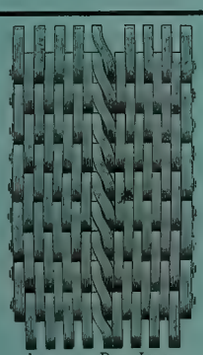

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ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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CHARLES D. JENNEY, Electrician

BRAINARD ROBISON, Secretary.
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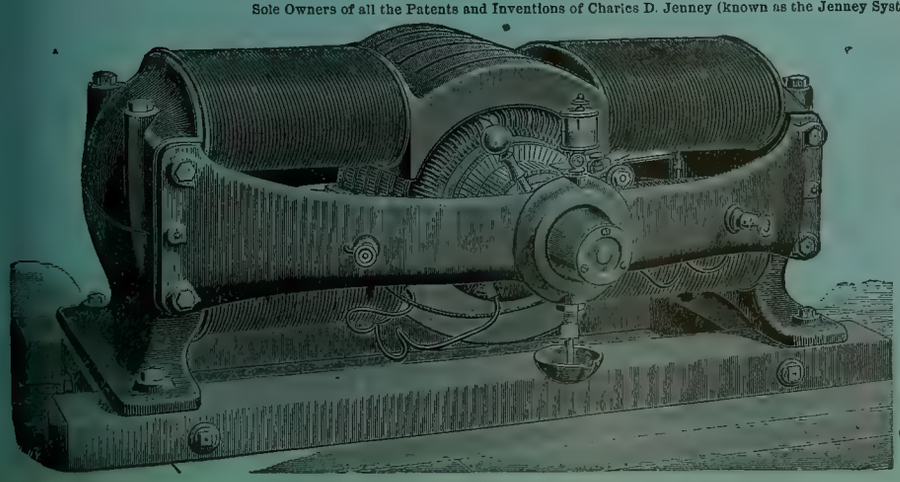
JENNEY ELECTRIC COMPANY.

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to Furnishing Mines, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St

INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

EASTERN OFFICE:
178 DEVONSHIRE STREET, BOSTON.

WESTERN OFFICE:
PULLMAN BUILDING, CHICAGO, ILL.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.

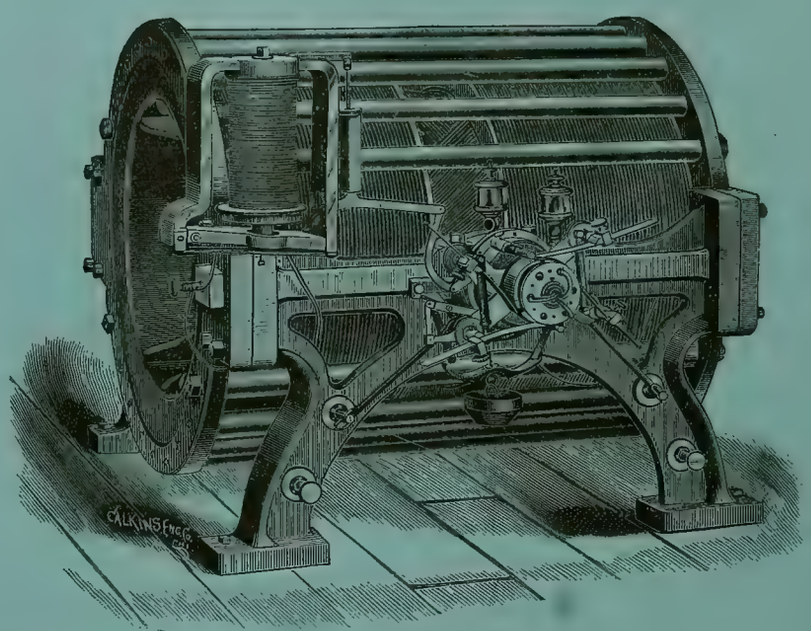
SERIES LAMPS

— FOR —

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883.
First Prize: Best System of Arc Lighting, Cincinnati Industrial Exposition, 1883.

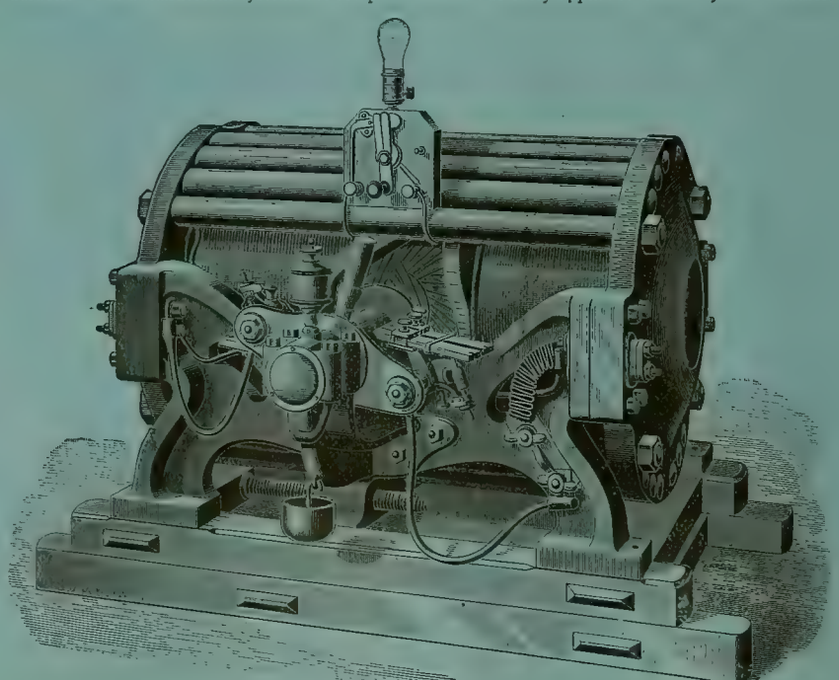


This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.



SELF-GOVERNING ELECTRIC MOTORS

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

MINNEAPOLIS, NOV. 17, 1887.

EDISON UNITED MANUFACTURING CO.,
65 Fifth Avenue, N. Y.

GENTLEMEN:

The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

U. S. OLD LAMP

IN GRAND OPERA HOUSE, MINNEAPOLIS.

WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful Indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of J. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=$11\frac{50}{100}$ per H. P.
EDISON 348 LAMPS REQUIRING 54 H. P.=$6\frac{44}{100}$ per H. P.

COMMENTS ARE UNNECESSARY.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, MANAGER. 216 LA SALLE STREET, CHICAGO.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

Electric Light Carbons

AND

BATTERY MATERIAL.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

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LAVA INSULATORS.

ABSOLUTELY

Fire, Water and Acid Proof.

MADE FROM MODEL IN ANY SHAPE.

Have stood severest tests, can furnish highest testimonials from largest manufacturers of Electrical machinery in the world. Samples and estimates sent on application. Cheaper than any reliable insulation.

D. M. STEWARD M'F'G CO., Chattanooga, Tenn.

January 1st, 1888, we removed our entire plant from Cincinnati to Chattanooga, where we have greatly increased facilities in all departments.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

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BRANCH, 521 DELAWARE ST., KANSAS CITY.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

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MUTUAL LIFE BLDG.

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Plans and Estimates Furnished for all kinds of Incandescent Lighting.

SAWYER-MAN ELECTRIC COMP'Y. SAWYER-MAN SYSTEM. TRADE MARK

Philadelphia Office:

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BOSTON OFFICE:

No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

EDISON'S OPINION.

Geneva Non-Magnetic Watch Company:

Gentlemen:—During the past six months I have submitted the watches containing Paillard's Patent Non-Magnetic Compensation Balance and Hair Spring to test in different fields of magnetism. I find them exempt from magnetic influence, however strong, and practically no retardation of the balance, nor change in rate occurs, even when in actual contact with Dynamos or powerful Electro-Magnets.

I have been carrying one of your watches, and going around Dynamos and other Electrical Appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance a most wonderful and valuable invention, not only for workers around Dynamos, but wherever accuracy of time is required.

Very truly,

Orange, N. J., Dec. 7th, 1887. *T. A. EDISON.*

For Full Information about the Watches referred to in the above Testimonial, address:

Geneva Non-Magnetic Watch Co.

(LIMITED.)

177 & 179 Broadway, New York.

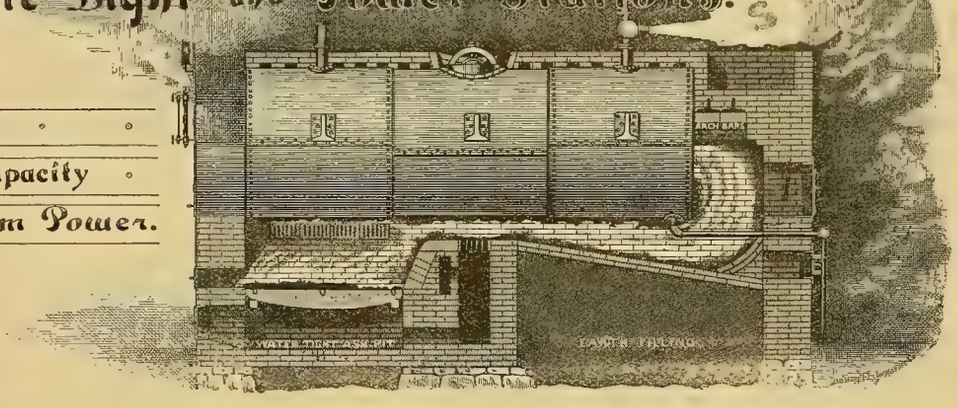
The Jarvis Engineering Co. Boston, Mass.

Complete Steam Plants

for Manufacturing Establishments.

also make a Specialty of

Electric Light and Power Stations.



Economy of fuel with increased capacity of Steam Power.

THE GREATEST OBJECT TO BE OBTAINED IN PRODUCING STEAM POWER

IS TO USE FUEL WHICH WILL GIVE

The Greatest Amount of Steam at the Least Possible Expense.

THIS THE JARVIS BOILER SETTING AIMS TO DO.

IT HAS NO EQUAL. OVER 3,600 IN USE. COMPRISING OVER 300,000 H. P. BURNS SCREENINGS, SLACK, WET SAWDUST, WET HOPS AND ALL KINDS OF REFUSE FUEL WITH LARGE ECONOMY.

The following list represents the electric light stations and steam plants which have been equipped by the Jarvis Engineering Company (either in whole or in part), in the different cities and towns, up to the present time.

Thomson-Houston Co. System,	65 Stations.	Weston Electric Light System,	8 Stations.
Edison Electric Light System,	46 "	American System,	7 "
Brush-Swan Electric Light Co. System,	14 "	Jenney Electric Light Co. System,	6 "

The following concerns have used the Jarvis Patent Boiler Setting in their mills. Those giving the second or more orders are marked with a *; and we wish to call especial attention to this fact, for if customers were not fully satisfied we should never get duplicate orders. This result tells more than volumes of certificates.

Of Cotton Mills,	*41	Of Phosphate Works,	*6
Of Woollen Mills	*42	Of Iron and Steel Works,	*5
Of Paper Mills,	*29	Of Flour and Grain Mills.	*6
Of Boot and Shoe Manufactories,	*14	Of Chemicals,	*8
Of Machinery,	* 7	Of Tobacco,	*4
Of Water Works,	12 Stations.	Of Salt Works,	*5
Of Engine and Machine Works.	*10	Of Breweries,	*8
Of Soap Works,	* 7	Of Miscellaneous,-	*32

WE ARE PREPARED TO FURNISH COMPLETE OUTFITS OF MOTIVE POWER FOR

ELECTRIC LIGHT AND POWER STATIONS.

Including ENGINES, BOILERS, IRON STACKS, BOILER FURNACES, STEAM PUMPS, HEATERS, INJECTORS, Etc.

SEND FOR NEW 1888 CIRCULARS. CORRESPONDENCE SOLICITED.

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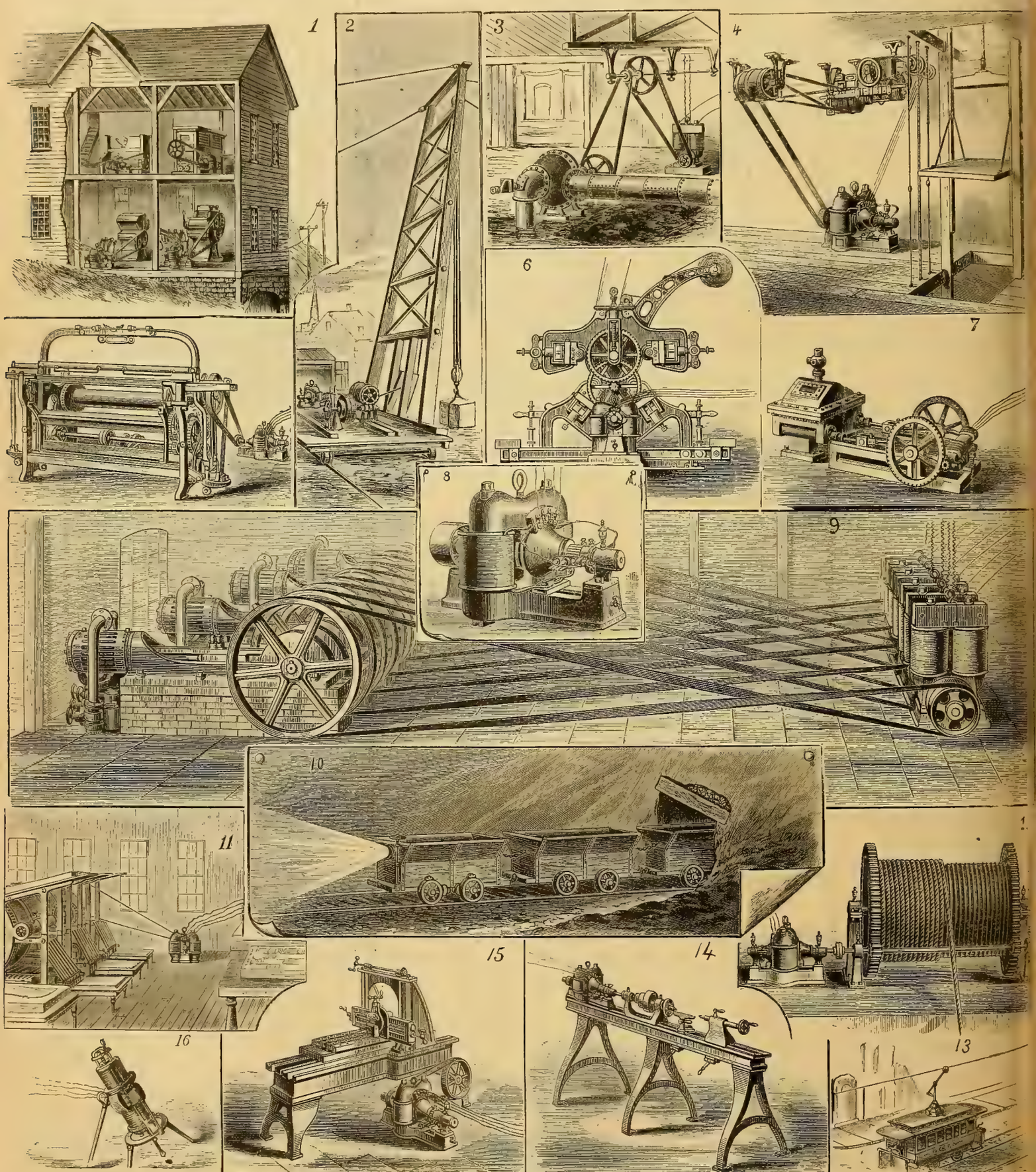
81 Lake Street, CHICAGO, ILL. — H. A. GLASIER, Manager.

109 Liberty Street, NEW YORK CITY. — J. N. PRATT, Manager.

SPRAGUE ELECTRIC RAILWAY & MOTOR CO.

Office, 16 & 18 Broad St., New York.



THE SPRAGUE SYSTEM OF ELECTRIC DISTRIBUTING POWER.

No application of Power yet made is so neat, noiseless, reliable, convenient, safe and economical for all Industrial purposes, as is the SPRAGUE ELECTRIC MOTOR. It is now used in a great variety of industries in this country; at points where the primal energy is near at hand; and in others where it is miles distant. The above cut shows some of the applications made.

1. Grain Mill. 2. Hoisting Crane. 3. Motor run by Turbine. 4. Elevator. 5. Loom. 6. Calico Printing Machine. 7. Mining Pump. 8. Sprague Motor. 9. Central Station 10. Mine Tramway. 11. Printing Press. 12. Mine Hoist. 13. Street Car. 14. Wood Lathe. 15. Metal Planer. 16. Mining Drill.

SEND FOR CIRCULARS. CORRESPONDENCE SOLICITED.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

Arc and Incandescence

Electric Lighting Apparatus

CHICAGO OFFICE:

130 Washington Street,

CHICAGO, ILLINOIS.

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MANCHESTER, CONN.

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R. H. MATHER, WM. A. ANTHONY, Consulting Electricians.

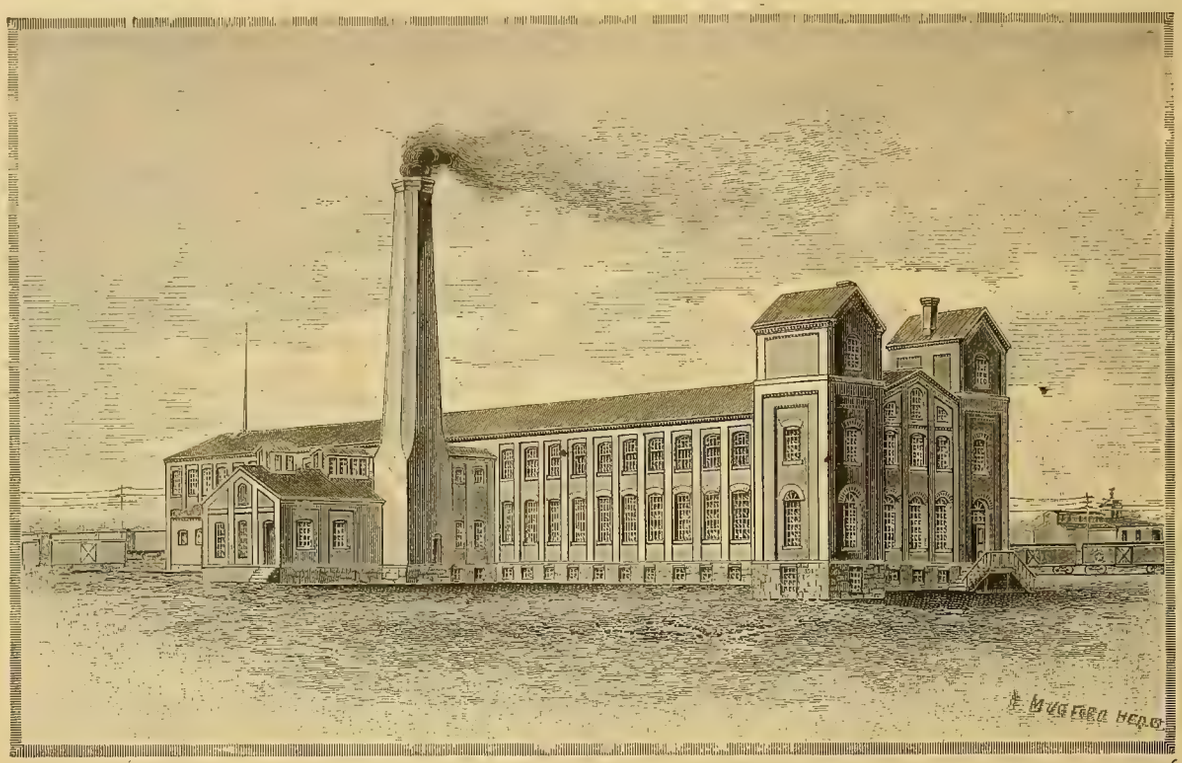
New York Office, 35 Broadway. Chicago Office, 38 LaSalle St. Boston Office, 143 Federal St. Cincinnati Office, Carlisle Building.

INSTRUMENTS

—OF—

PRECISION.

We make instruments for Electrical Measurements, adjusted to any degree of precision required for any purpose. Resistance boxes are made with any required series of resistances, with and without proportional coils for bridge. All resistances are adjusted to legal ohms by standards tested at the Cavendish Laboratory and certified by the British Association Committee.



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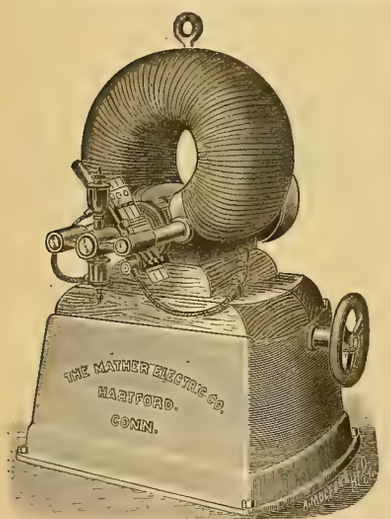
RESISTANCE BOXES

required for physical research, all the coils will be made from one piece of wire, to insure a uniform temperature coefficient. Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order. Ammeters, Voltmeters and Resistance Coils will be calibrated, and constants furnished.

The Mather System for Incandescent Lighting.



The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

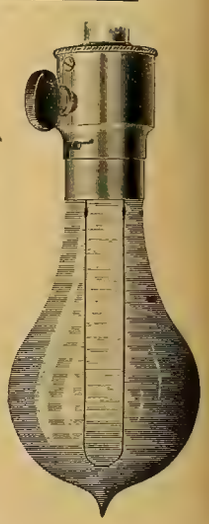
DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.

MOTORS.

We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuits.

Incandescent Lamps and Sockets for Private Users.



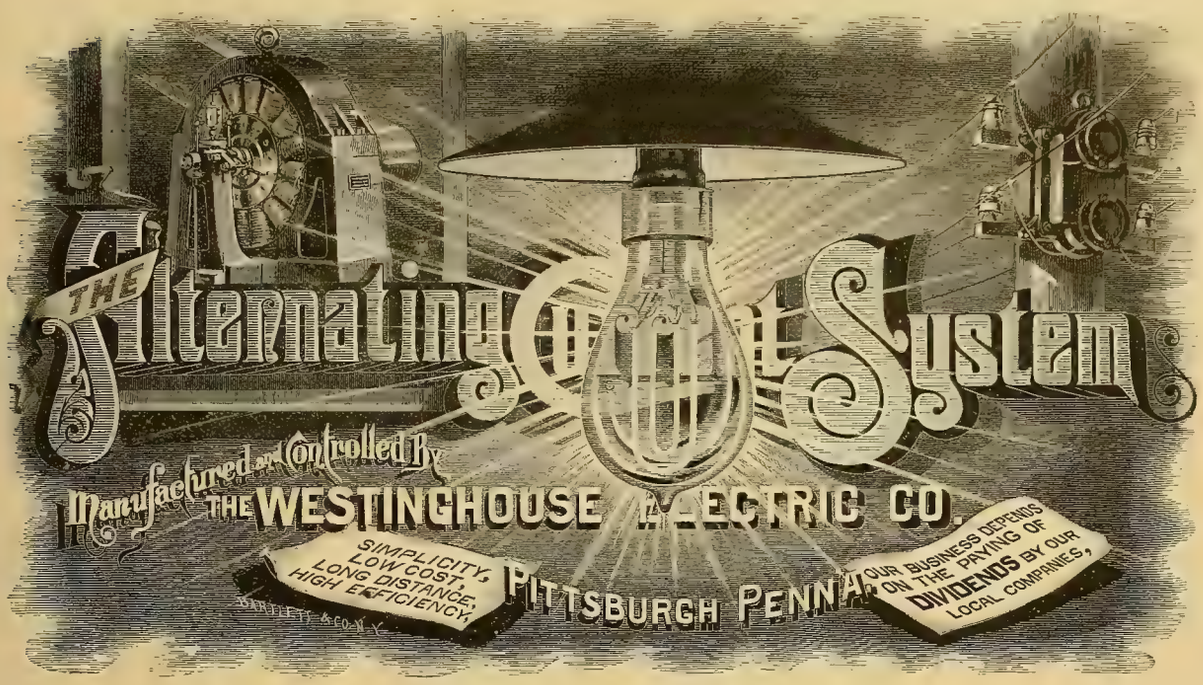
We Furnish Lamps of 16 Candle Power each, for Potentials from 50 to 110 Volts, for use with any Machine.

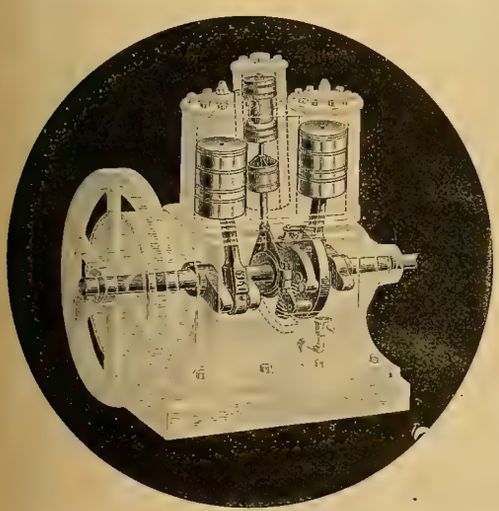
Chicago Office, 38 La Salle Street.

The Tucker Electrical Manufacturing Co.,

35 Broadway, New York City.

Selling Agents of the MATHER ELECTRIC COMPANY for the States of New York, New Jersey and Pennsylvania.





The Single-Acting and Self-Lubricating Principles

Mark the second great advance in Steam Engineering, and represent the Highest type of

COMMERCIAL ECONOMY.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

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CONTROLLED BY

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The D. A. Tompkins Co.
36 S. College St..Charlotte, N. C.
46 S. Pryor St.....Atlanta, Georgia.

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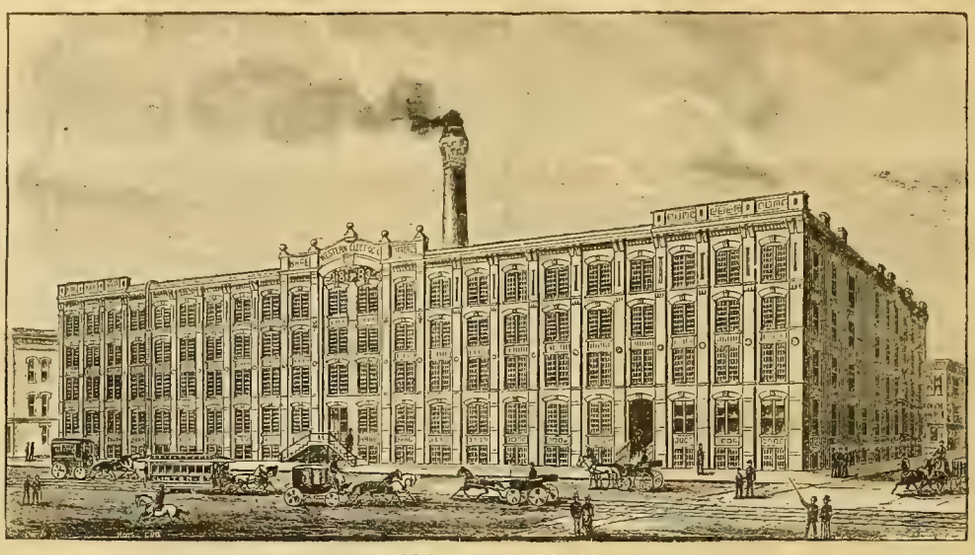
FARADAY CARBON COMPANY

PITTSBURGH, PA.

WESTERN ELECTRIC COMPANY,

Chicago. London.

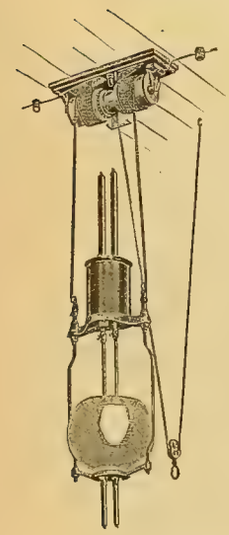
New York. Antwerp.

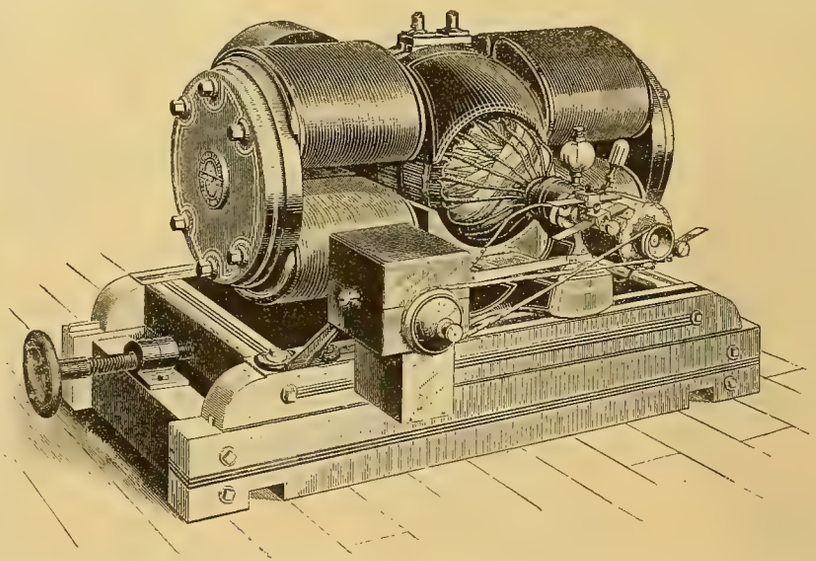


CHICAGO FACTORY.

Electric Lighting Apparatus

OUR SYSTEM OF ELECTRIC LIGHTING IS COMPLETE IN EVERY DETAIL, AND IS UNEXCELLED IN THE EFFICIENCY AND WORKMANSHIP OF THE APPARATUS, IN THE BRILLIANCY, STEADINESS AND COLOR OF THE LIGHT PRODUCED, AND IN AUTOMATIC REGULATION. WE FURNISH DYNAMOS TO GIVE ANY REQUIRED CURRENT. THE HIGH GRADE OF WORKMANSHIP AND THE EFFICIENCY OF OUR DYNAMOS





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EVERY SATURDAY

Vol. II. CHICAGO, FEBRUARY 18, 1888. No. 7.

The Slattery Induction System.

For many years past a number of the brightest electricians of the world have been engaged in a close study of the laws governing the actions of alternating currents, and especially have directed their efforts towards solving the problems underlying the operations of induction coils or converters, used as one of the prime factors in a system of electrical distribution.

M. M. M. Slattery, one of the earliest practical workers in this latter direction on this side of the Atlantic, who has lately joined issues with the Fort Wayne Jenney Electric Light company, has devoted much time during the past three years in working out and putting in practice a system of electric lighting in which inductoriums are used, and which, from all accounts, appears to leave little to be desired in the perfection of detail and in the success in general which has attended his practical efforts in this extensive field.

Mr. Slattery's first experiments were in the line of Gaulard & Gibbs' work, with a view to increasing the efficiency of the converter used in this system and reducing it to a commercial basis. At an early stage, however, when working ing in this direction, he became convinced that, owing to fundamental electrical difficulties which existed in this system, and which appeared to him impossible to eradicate —reference is had especially to the development of counter e. m. f. with the coils placed in series in the line— he turned his attention to the utilization, instead of the suppression of certain laws which govern the action of inductoriums. His next step was, instead of placing the inductoriums in series in the main line, as in the case of Gaulard & Gibbs' system, to dispose of them in multiple arc, and from that period up to the present time he has been, as stated, engaged in perfecting the multiple arc inductorium system. In working out this system, Mr. Slattery has been ably assisted by Robb MacKie, who is assistant electrician of the Fort Wayne Jenney Electric Light company. The various factors comprising the system are shown in the accompanying drawings.

The principal features of the alternating systems of electric lighting are so well understood that it might be considered superfluous to give any detailed description thereof at this time. In a few words, however, it may be stated that the first plant put in practical operation by Mr. Slattery, in Woburn, Mass., had a primary main line pressure of 1,000 volts at the poles of the primary coil and 50 volts at the poles of the secondary coil of the converter. These converters were placed in multiple arc in the circuit, and are to-day working as perfectly as upon the first day they were set up—more than two years ago.

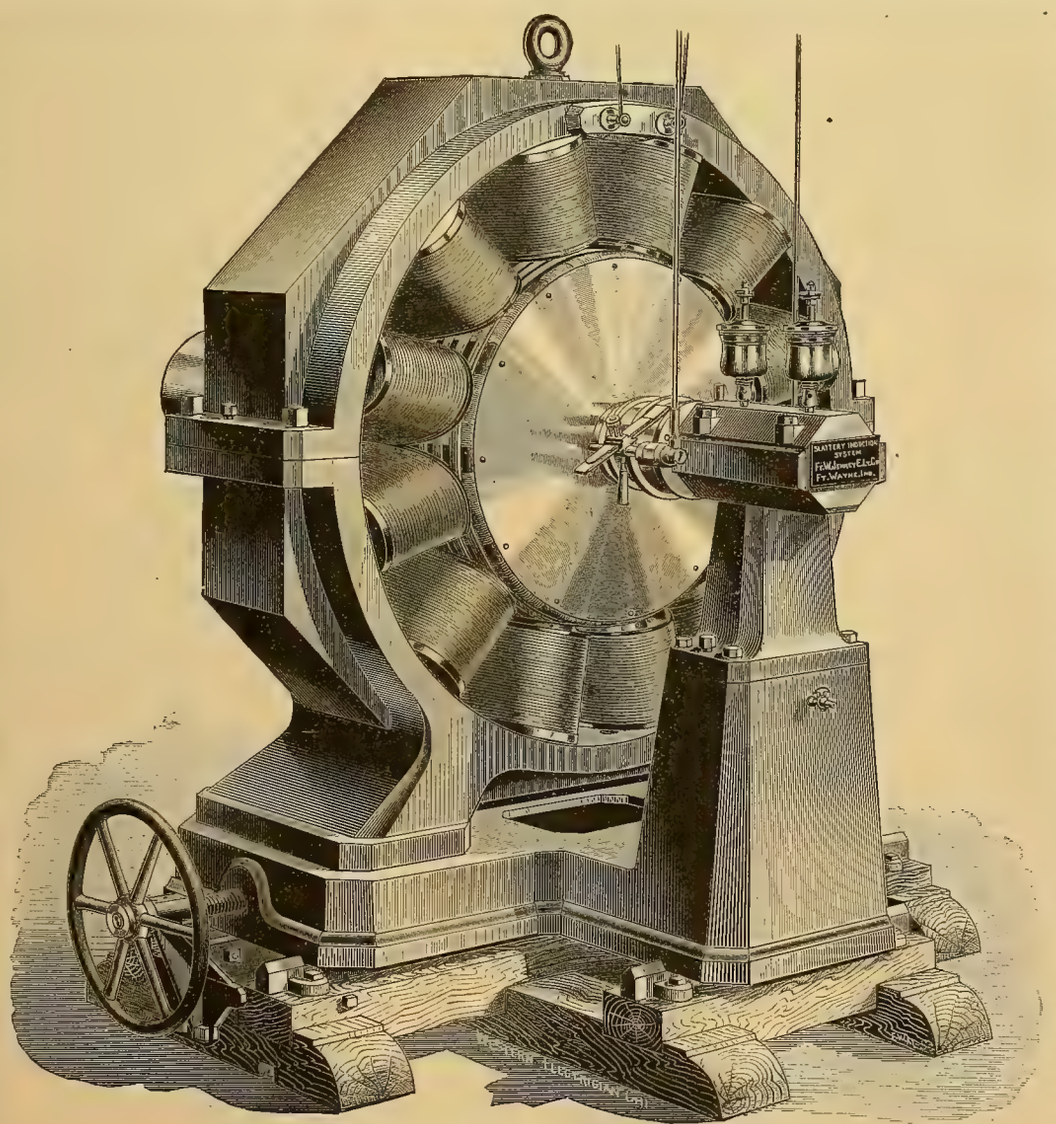


Fig. 1—Alternating Current Dynamo.

Dynamos.—In deciding upon the particular type of dynamos most suitable for the work to be done, two were chosen, built, and put into practical operation. These types were the Siemens' disk armature and the Lontin, and after careful and exhaustive test, the Lontin type was selected, and with many improvements, electrical and mechanical, is accomplishing remarkable results wherever it has been put to work.

It will be seen from the engraving, Fig. 1, that so far as symmetrical mechanical construction is concerned, in which is combined rigidity and simplicity throughout, the builders are warranted in the confidence they justly feel in the successful performance of the work that has to be accomplished by it.

When it is said that upon the armature of the machine capable of supplying 1,800 16 candle power 50 volt lamps there are but 35 pounds of copper wire, it will be understood by those familiar with the business that the ideal construction is closely approached, and that the greatest care has been exercised in electrically disposing of every part of the dynamo, with a view of obtaining maximum efficiency from the minimum of mass. After careful experiment, it was further decided that it was more simple, more easy, and safer to operate a separately excited dynamo than a self-exciting dynamo. Both kinds were built, and the results which have followed the adoption of the separate excitation would seem to indicate a judicious selection.

Fig. 2 illustrates the type of exciter employed with this system, and, as will again be seen, simplicity of parts characterizes the mechanical skill which has been employed in its construction.

Converters. — An exterior view of the converter is shown in Fig. 8. The interior construction is briefly described: The copper wire is wound upon a core consisting of insulated iron plates, rectangular in form, divided centrally, and placed back to back, previously having had a sufficient portion of the center cut out, in which space the coil referred to is wound. The magnetic circuit is then closed around the sides of this coil by the other half of the rectangular plate referred to. The coefficient of induction in this converter is equal to a volt per five inches of wire, the ratio of conversion twenty to one, and there are nearly two pounds of iron per secondary ampere capacity. The working pressure of the system is 1,000 volts at the poles of the primary coil and 50 volts at the poles of the secondary coil.

A special insulating compound is used in these converters, and this is of such a character,

that the chances of cross circuiting of the convolutions of the primary coils are very remote indeed. In each converter, conveniently placed, are primary and secondary fuses, which are easy of access, and exceedingly safe in event of a

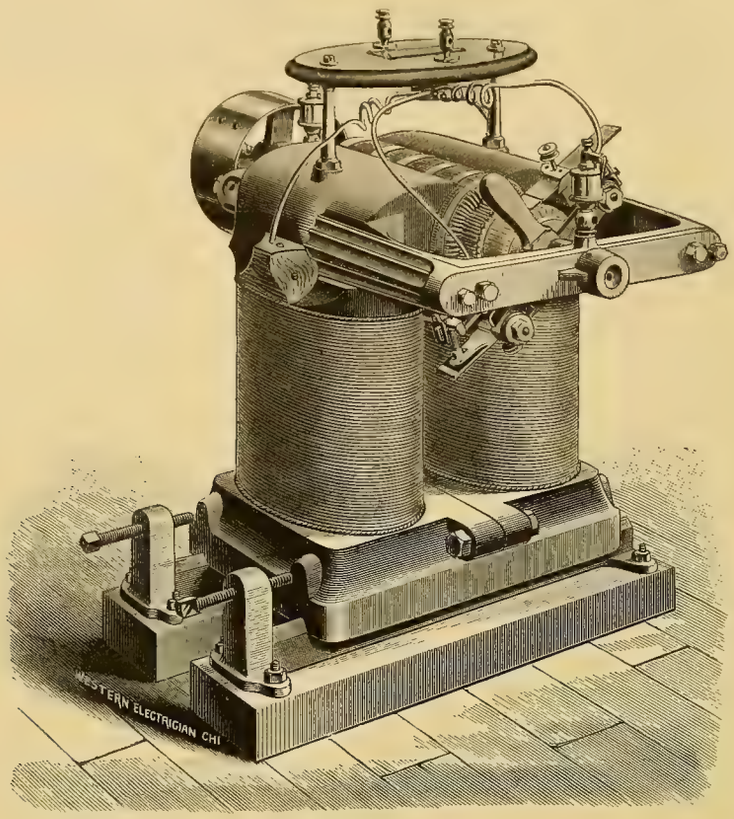


Fig. 2—Exciter.

necessity arising for the renewal of a fuse upon the line circuit; a simple device in connection with the primary fuse enables the attendant to cut the converter entirely out of circuit during the introduction of a new fuse, thereby enabling him, without any danger whatever, to make and leave everything secure about the connections of the apparatus.

Instruments.—The central station instruments, viz., pressure indicator and ammeter, are especially constructed for measurements of alternating currents and potentials, and are both simple in construction and extremely delicate in operation. A description of one instrument will answer for both. Two flat metallic spools divided at one side, have wound thereon the requisite number of convolutions of wire. These spools are mounted upon a rectangular frame common to both, one being placed in eccentric relation to the other, in order to modify the parallel plane of the convolutions of the respective coils, for the purpose of reducing self-induction. In order to obtain a due and proportional measurement of current or potential in relation to the spools, a circumferentially disposed inverted horse-shoe shaped piece of iron is attached to a central shaft, which is mounted upon jeweled centers, and carries a pointer, which is deflected according to the varying potentials and strength of current.

The instruments are placed in a case having a glass front, and are disposed in a conspicuous position in the central station, so that the attendants may see at any moment what is taking place in the external circuit.

Meter.—Not the least of the important factors in this system is a meter for measuring the energy supplied to each customer, the extreme delicacy and accuracy of the working of which, can not be too highly estimated.

Multiple Arc Coupling Device.—A very simple central station device is used for safely and easily coupling alternating current dynamos in multiple arc. To accomplish this object there have hitherto been used electro-magnetic devices, synchronizers, etc., but as these devices require very rapid action and necessitate exceedingly great care in operation, they can not always be depended upon to perform successfully the work required of them. In the case of the apparatus that Mr. Slattery uses for this purpose, the coupling of dynamos in multiple arc is reduced to a basis of such simplicity that an ordinary central station assistant will have no difficulty in coupling and running the dynamos together.

Recorder.—Another useful central station apparatus, devised by Mr. Slattery is chiefly to be used by central station superintendents. This device is placed by the superintendent in proper relation in the circuit for the work it has to do—at night, for instance as he leaves the station. In the morning when he returns he consults the apparatus, and sees exactly the extent of the irregularity due to the carelessness of the attendant, and the electrical disturbance which may have taken place during his absence. This will, no doubt, commend itself to central station superintendents as a means of compelling, if possible, more careful performance of duty, a laxity of which has frequently resulted in many irregularities unpleasant to relate.

Arc Lamps.—This system would not be complete without an arc lamp and motor. Mr. Slattery makes a special converter for operating arc lamps in multiple arc, which, although it has not yet been placed on the market, has been for some time working successfully at the factory, and preparations are now being made to manufacture these lamps and introduce them for public use. An excellent feature about this apparatus is that arc lamps of various illuminating capacities can all be used in one general system, these capacities varying between 300 and 2,000 candle power. The converter constructed to work in connection with this lamp is only a trifle larger than an ordinary exterior arc lamp cut out, and in consequence of such desirable compactness, may be disposed of with as much ease.

Motor.—The motor referred to is still in an experimental stage, but in an advanced one, and considering the activity and ingenuity displayed by Mr. Slattery, and his able assistant, Mr. MacKie in working out of this system, it may be fairly anticipated that before long the success which has characterized their efforts in other directions, will be fully realized in this.

Wiring Fixtures.—Fig. 4 is an adjustable clamp branch connector, used to connect branches with the main line and enables the lineman to dispense with the use of solder, rendering the work more expeditious, and making a far more effectual joint. In conjunction with this branch connector, is used a branch switch safety fuse, Fig. 5, which is placed at the junction of a primary branch and the main line. Here again the safety of those whose duty it is to replace burnt-out fuses is considered, as they can by means of the switch, shown in the interior of the fuse box, disconnect the fuse terminal from the line and then safely adjust the fuse. One of these boxes is placed on each side of a parallel circuit. Figs. 6 and 7 are smaller sizes of Figs. 4 and 5, and are employed to connect the primary coil of converter with the external primary circuit. This method of introducing so many fusible devices throughout the system might be considered by some as superfluous but

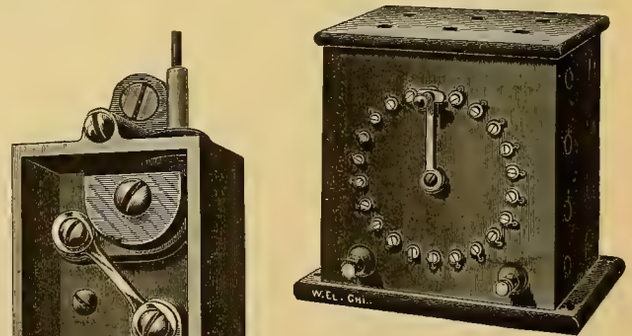


Fig. 3—Resistance Box for Exciter.

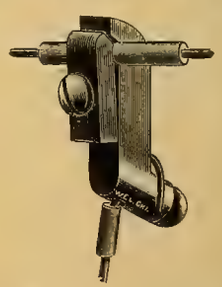


Fig. 6—Clamp for Branch to Converter.

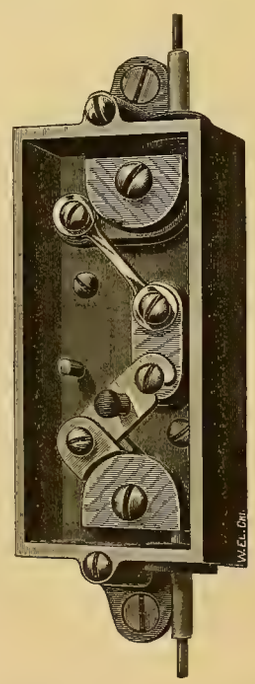


Fig. 5—Branch Fuse Box (cover removed.)

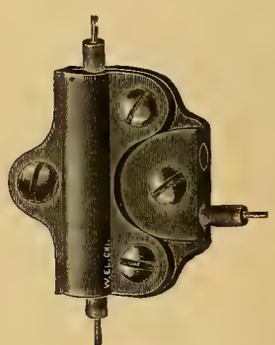


Fig. 4—Branch Clamp.

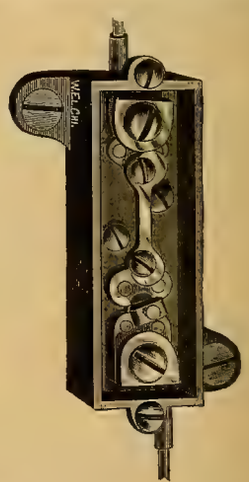


Fig. 7—Fuse Box for Branch to Converter. (cover removed).

The Slattery Induction System—Primary Circuit Details.

if there is an error in question at all it will be considered as being on the side of safety.

Figs. 9 to 15 represent the fusible wiring details, the special object in the construction of which has been greater facility in wiring and safety when wired, and evidences thorough familiarity with both plain cleat and molding wiring, and every requirement which may arise in this branch of work.

Fig. 15 represents the lamp, shade-holder and key-socket. The lamps have a working life of some eight hundred hours, and twelve 16 candle power 50 volt lamps may be operated with the expenditure of one horse power of energy—results that are decidedly creditable.

A striking illustration of the good results that must follow the intelligent and energetic management of the manufacture, upon approved scientific principles, of electric light apparatus, is found in the rapid growth of the works of the Fort Wayne Jenney Electric Light company at Fort Wayne, Ind.

It is a fact that each year this company have been forced either to enlarge their works or to move to new quarters more ample to accommodate their business. The annual addition, made early in the year, and now in use, is worthy of a brief description. The structure is of brick, three stories in height, and has a ground plan of 112 by 41 feet. The lower floor is entirely occupied by the store room, which contains all the new goods, prepared for shipment, and all goods received for the works. The arrangement is such as to economize space as far as possible. The second and third stories are entirely given up to the incandescent department, which now for the first time has the accommodations and conveniences which enable it to keep abreast of the large orders. On the second floor is the converter room, 30 by 40 feet, where, at long tables and benches, thirty girls and ten men wind the coils for the inductoriums, insulate the iron and build up the cores. This department is to be extended so as to occupy half of the second floor of the old main building, when its capacity will be more than doubled. The rest of the second floor is devoted to the manufacture of instruments for incandescent plants, such as electric meters, current indicators, potential indicators, switches, regulators, safety cut-outs, sockets, etc. This floor has its own store room, containing the products of the department. Over one hundred men and girls are here employed.

The third floor contains the carbon room, where the filaments are made for the incandescent lamps; the pump room, fitted with 100 mercury air pumps and six mechanical air pumps, a large room for the glass blowers, the photometer room, laboratory, stock room, closets, wash room, etc. The employes on this floor number 100, and many more must soon be added.

Every room is abundantly supplied with power, magnificently lighted by day and by night, and about the whole building there is an air of cleanliness and order that indicate the intelligence and discipline that pervade the works. The new building is on the lines of the Pittsburgh, Fort Wayne & Chicago and Grand Rapids & Indiana railways, and has a switch and shipping platform of its own.

It was expected that the relief the construction of the new building would afford the arc department, which at once expanded over the whole of the older buildings, would be lasting, but Superintendent Charles S. Hilton has already asked for more room for his 100 employes, and the company has placed an order with its architects for a new three-story building, 200 by 50 feet, to be erected early this year. When it is ready for occupancy, Mr. Hilton's force will be largely increased. The electricians of the Fort Wayne Jenney company are M. M. M. Slattery, the inventor of the now famous alternating system, and Robb Mackie. In all departments of the business, Manager R. T. McDonald has exercised a wise selection of very capable assistants.

Sprague Electric Railway at Richmond.

Ayers D. Lundy, the engineer connected with the western office of the Sprague Electric Motor company, has sent the following information from Richmond, Va., where he is assisting in the installation of the Sprague railway system in that city: "The road has been opened to passengers since the 2nd of February and has been operated with marked success, notwithstanding the fact that a grade supposed to be 8 per cent was found to be wrongly graded, and it is fully 10 per cent. The past week has been memorable for mud and sleet in Richmond, the wheels of the cars running through liquid mud four to six inches in depth. We have found no trouble from water or mud. The switches control the cars perfectly, giving any desired speed up to the maximum and any power applied to the wheels similarly. The drivers or 'motorneers' have no difficulty in managing the cars. The under-contact works admirably and the curve work is light and graceful. Those who doubt the feasibility of electric propulsion for an entire city railway system will find here in operation what would convince the greatest sceptic and satisfy the most sanguine believer in electric traction."

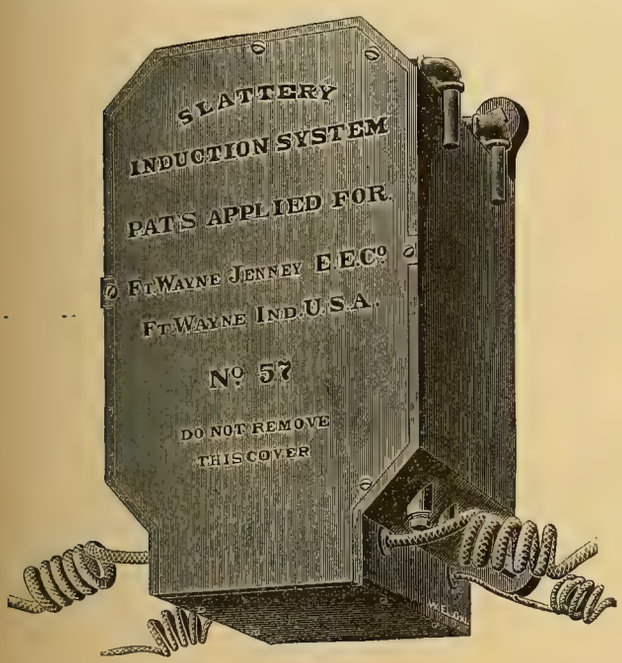


Fig. 8—Converter.

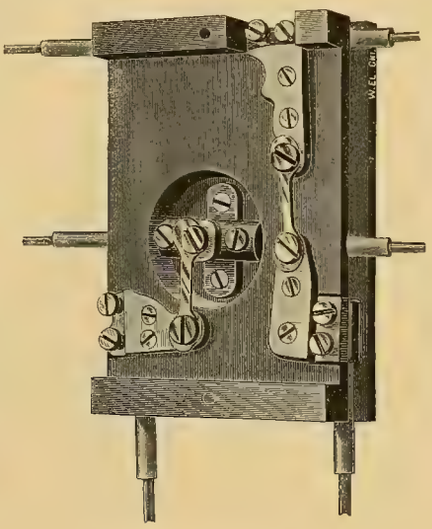


Fig. 9—Entering Fuse Box (cover removed).

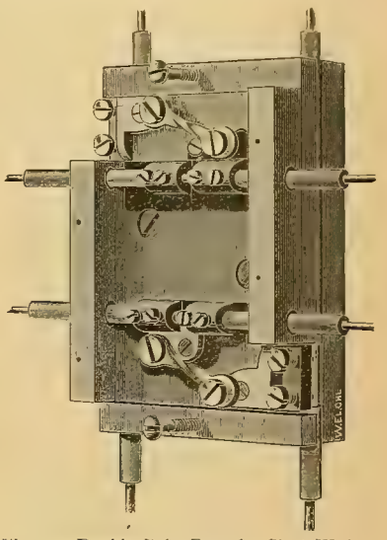


Fig. 10—Double Pole Fuse for Cleat Wiring. (cover removed).

Fig. 11—Single Light Fuse for Cleat Wiring.

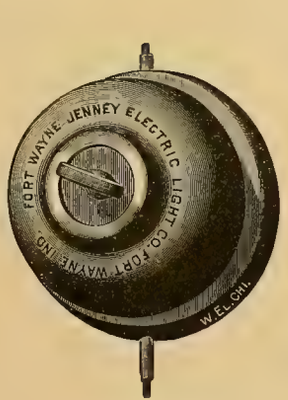


Fig. 12—Wall Switch.

Fig. 13—Wall Socket.

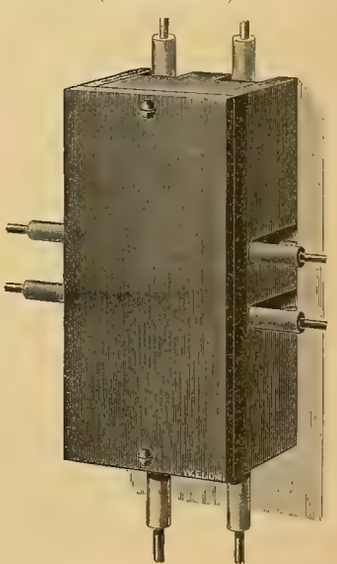


Fig. 14—Double Pole Fuse for Molding Wiring.

THE SLATTERY INDUCTION SYSTEM.—SECONDARY CIRCUIT DETAILS.

Edison Companies' Convention.

One of the most interesting conventions of the representatives of the Edison companies was held a week ago last Wednesday and Thursday, at the Grand Pacific hotel, Chicago. The attendance was large, and the discussions, as they touched upon many questions of the most vital importance, were of more than usual interest.

Mr. Beggs, president of the association, stated that his company used no wires of lower grades than rubber insulation for interior work in New York City. The question of insurance came up for discussion and reference was made to the difference in rates allowed by companies where buildings were lighted by electric currents of low potentials. The question was referred to a committee appointed to confer with the National Board of Fire Underwriters. It was reported that the total amount of money invested in Edison central stations in the United States aggregated $11,500,000.

Mr. Edison was present and made a characteristic address, in which he discussed high and low potential lighting from an economical standpoint. He gave a concise statement of the working of the two systems. His remarks were listened to with the closest attention.

E. H. Johnson gave a clear statement of the several suits now in litigation.

The matter of lighting by meter or by contract was brought up. The general opinion seemed to be that for lighting, the meter was the preferable system and for power the contract system was to be preferred.

Several interesting ampere load diagrams were exhibited.

In most cases the different stations has shown an increase of 100 per cent. in their business during the last year. The convention adjourned Thursday evening to meet in August next in Boston or at another eastern city to be decided upon later.

A number of the delegates remained until Friday to visit the many points of interest in the city. They were entertained by local representatives at the convention in the most cordial manner. They expressed surprise at the large number of isolated electric lighting plants which they considered remarkable. Nearly every store and building of prominence in the city had its own plant and a profusion of lights. The last eastern delegate left the city Friday evening. Their stay here was profitable from a business standpoint and social pleasure of the visit will make the convention one long to be remembered.

Execution by Electricity.

A correspondent in the New York *World* regarding the plan proposed to the New York legislature for executing criminals under sentence of death by electricity says: For a score of reasons the proposed system should be adopted. Electricity is the swiftest and most certain of all possible means by which death may be inflicted. Ninety-five feet a second is the estimated speed of nerve sensibility. Electricity travels 180,000 miles in a like space of time. The brain is paralyzed before it can feel the shock, the victim of the current passes from life to death without knowing the blow. Obviously, there is a twofold gain in this method. First, it entirely prevents a mishap. The current passes when the fatal joining of the wires occurs, and death is given. The distant dynamo gives no sound the condemned man may hear. He is led to a chair and seated. One metallic conductor is placed against the nape of the neck, salt water being applied to the hair to enable it to transmit the current. The other conductor is placed on top of the head, the hair being wet, or on either temple or both. The connection is then made and the man is dead on the instant.

To send the current from head to foot, as proposed, is obviously a bad method. A powerful convulsion would inevitably result; the muscles would still be in action after death. Passed through the brain, the full effect on the life centers would be felt and no convulsion would follow. To have this occur at the state prison is an eminently good feature. There it fitly belongs, and the rigid discipline of such institutions would prevent the influx of visitors common to city prisons. Besides, the moral effect upon the other convicts would be good.

To have the day and the hour concealed from the dead man would rob his last days of the melodramatic interest they possess for his fellows

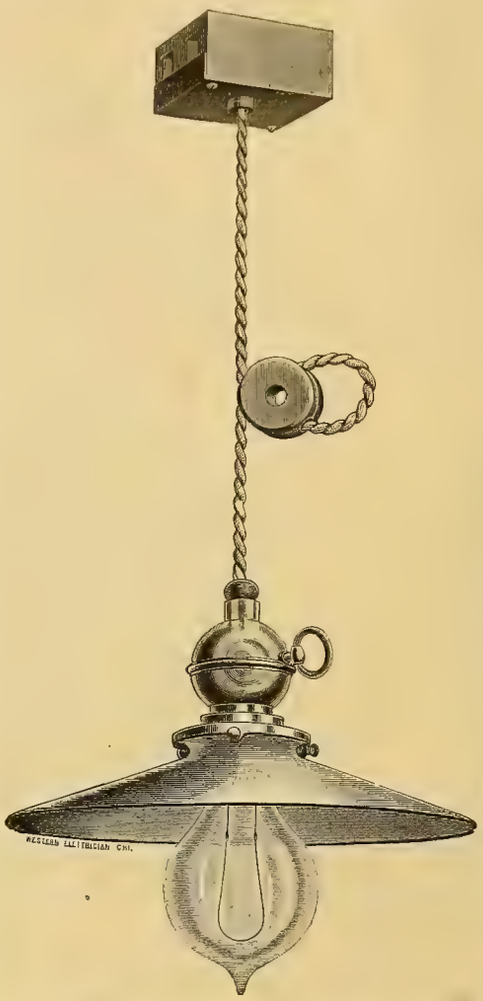


FIG. 15— THE SLATTERY INDUCTION SYSTEM—SINGLE LIGHT FUSE AND LAMP FIXTURE COMPLETE.

in crime and make the fate more terrible. There would be no halo about the head of a felon who journeys to the state prison merely to be hurled on some unspecified day and unknown hour by a swift and silent agent out from the world he has offended. No boasts of "dying game," no incidents of his last day and last hours; nothing but his being swallowed up living by the grim walls of the penitentiary and cast forth again some day, dead.

As to the execution being secret, viewed only by the coroner's jury, there is nothing to be said in disfavor. The legal taking of life is at best revolting, and the more privacy the better. Besides, this robbing the murderer of his last swagger and of his sensational last appearance, will divest crime of one of its chief glories.

Commodore Gerry's report is full of good points and is commendable for good taste and good judgment. Civilization demands the life of murderers as a measure of prevention. Most states which have abolished it have had to return to it. It is a public necessity that murderers should die, but humanity demands that the method shall not be barbarous, the spectacle public, nor the criminal apotheosized in his taking off. Electricity, applied in a state prison, meets these requirements exactly.

Sprague Motors for Mining.

Recently mention was made in our New York correspondence of a large installation of Sprague motors for mining purposes, the principal points being a circuit of eighteen miles length, from which power was to be distributed at fourteen different points. Reference to the drawing in connection will bring out very interesting features. As will be seen the north branch of the Feather river, in Butte county, Cal., resembles a horse-shoe in outline. It flows through a rich gold producing territory around the Big Bend mountain. To drain the river bed and lay bare the gold bearing gravel the Big Bend Tunnel and Mining company drilled a tunnel, having an area of 12 feet by 16 feet, through 12,000 feet of solid rock and by damming the river diverted the flow of water from its natural course through the mountain to Dark Cañon which, as will be seen, secures an outlet in the west branch. But it was found that while the tunnel served its purpose admirably, mining operations could not be successfully carried on on account of the percolation of water through the gravel into the holes sunk in it. Power was wanted to operate pumps, for hoisting and like purposes and accordingly recourse was had to the electric motor as the most available power. The Sprague Electric Railway and Motor company have the installation in charge. The circuit, as stated, will be eighteen miles long. The dynamos will be driven

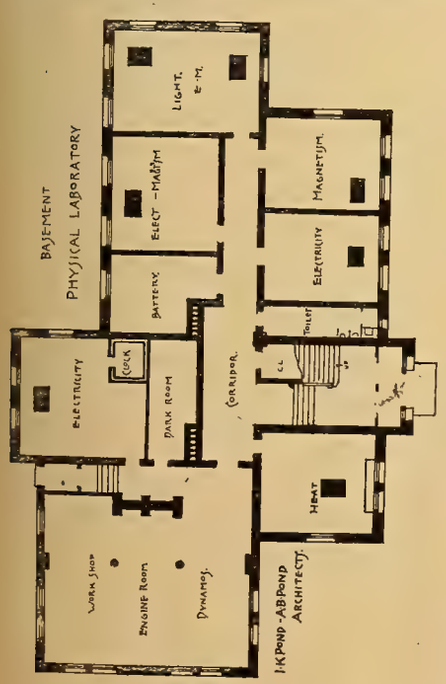
by water power which is furnished by the tunnel, a ditch about a mile long carrying the water from the tail of the tunnel to a place where a fall of 300 feet is obtained. This fall, together with the amount of water at command, will yield an almost unlimited power.

New Physical Laboratory—University of Michigan.

The facilities for instruction in physics at the University of Michigan have long been inferior to those of other departments. This deficiency was brought to the attention of the last state legislature, and appropriations were made, both for a large addition to the apparatus and for a new building for a physical laboratory, now in process of construction. The plans of the building and the purposes of the department are of interest to electricians, because of the large provision made for instruction in electricity on a commercial scale.

The basement and first floor plans will indicate clearly the general arrangement of rooms devoted to physics. The second story will accommodate the new department of hygiene. The greatest dimensions of the building are 72 feet by 115 feet. The main entrance is on the north side, and a descent of five steps leads to the basement floor, which is only two feet below grade. The basement rooms are eleven feet high, and are nearly all devoted to electricity.

Steam will be brought from the new boiler house in the vicinity, both for heating purposes and for power. It is proposed to place in the engine room a fifteen horse power engine of the best type for the exclusive use of the department. Piers in abundance are provided for instruments, and the west end of the building will be kept nearly free from iron. On the first floor, provision has been made for a large extent of slate tables supported on stone corbels set in the walls. The floors are of unusual stability, having 3″x 12″ and 3″ x 14″ floor joists, placed with centers one foot apart and strongly bridged. A matched diagonal pine floor will be covered with one of narrow maple. All partitions in the basement, and all but one on the first floor are of brick, without plaster. The lecture room will



seat comfortably one hundred and twenty-five persons, and will be arranged for darkening by means of the most recent and approved plans. It is proposed to place a storage battery in the battery room, both for experimental purposes and for lighting the building.

Dynamos and electric motors of different types will be provided. Some of the best instruments of English and German makes for measuring resistance, current, and potential, have already been procured.

While other branches of physics will not be neglected, special attention will be paid to electricity and magnetism in connection with the department of mechanical engineering. The new building for this department is nearly completed and is already in use. Here additional power can be obtained, either from a new thirty-five horse power Corliss engine, or a twenty-five horse power automatic engine built by the department for experimental purposes.

The physical laboratory will be ready for use by October 1st, and it is then proposed to offer to students in mechanical engineering special courses in electrical work, which may lead to the degree of electrical engineer. Since the electrical engineer is in a large part a mechanical engineer, students in the university will have ample opportunity to secure just such instruction, laboratory practice, and shop work as are needed to fit them for a professional career in applied electricity. Such students will find open to them all the advantages which the university offers in language, mathematics, chemistry, and physics; and they should be stimulated in the pursuit of their professional studies by the knowledge that the university has had under its tuition in past years, two men whose names are now so distinguished in applied electricity—Charles F. Brush and Professor Amos E. Dolbear, the one as an undergraduate, and the other as a post-graduate student.

This plan of providing technical courses in our leading universities, instead of establishing schools devoted to each specialty, is to be commended on the score of economy, and particularly because of the extensive and varied advantages which such institutions afford.

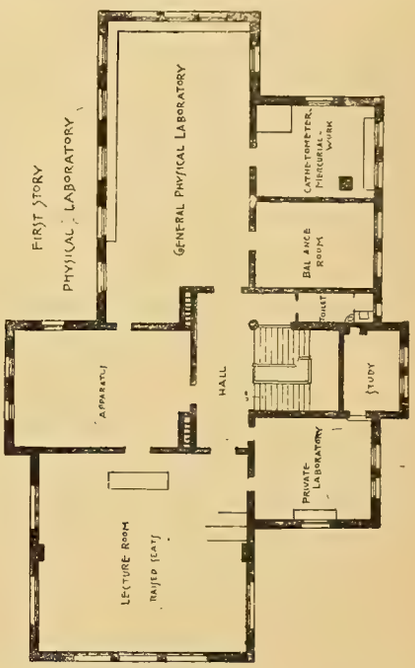
Electricity.[1]

By George H. Bliss.

Part II.

I have before me a Holtz machine. By turning the crank I am able to produce electricity which becomes manifest to you by the discharge between the electrodes of the machine. The force or motion applied to the crank of the machine is converted into that other form of force known as electricity. Again, by taking a piece of two different metals, say a few inches in length, and bending each into a semi-circular form, uniting the four ends and applying heat at the points of union electric energy will be developed. The force applied in the form of heat will be partially converted into thermo-electricity. I desire to say in passing that a great deal of attention and money is now being expended in the effort to produce electricity direct from coal by means of heat. If this can be economically accomplished it will abolish the use of the steam boiler and engine in the production of electric light and power. It is estimated that not over one-tenth of the stored energy in coal is saved in the manufacture of steam power. Ninety per cent. of the power applied to the dynamo from the engine may possibly be converted into electricity. Now, if the electricity could be made direct from the coal by some process which would economize a higher percentage of the stored energy in the coal it is evident that a great advance would be made. It is quite among the possibilities that in the near future thermo-electricity may supersede to a large extent the steam engine and such advance be made in the generation and application of power as will make present methods seem as antiquated as the old fashioned stage coach does in comparison with the railway train of today. It will certainly be very pleasant when the same fire which furnishes heat for our homes shall generate the electricity needed to illuminate them.

I have here an ordinary magneto bell used for the telephone calls. In it there is an iron armature wound with insulated copper wire which revolves between the ends of several permanent steel magnets. When power is applied to the crank, it is converted into electricity, which rings the bell. The magnets attract the armature and tend to hold it motionless. It is the force exerted in overcoming this attraction in revolving the magnets which causes the generation of electricity. The amount of electricity which can be generated is limited by the power of the steel magnets. The same method on a larger scale is employed in the dynamo for the generation of electricity for electric lights and other purposes, except that the steel magnets are displaced by an electro-magnet so arranged and connected that it becomes the exciting cause. This exciting electro-magnet is called the field magnet. The insulated wire wound upon the soft iron cores of the field magnet is proportioned to the work required from the machine. When a dynamo machine is used for the first time, the field magnets are slightly charged from an exterior source, usually a small battery. This is never necessary afterwards, for when the iron cores have once been highly charged, they will never wholly part with their magnetism, but will retain enough to start the machine into action. As magnetism is ex-



cited in the field magnets, and the armature begins to revolve, electricity will be generated. A small portion of this passes through the field magnets, making them stronger, which generates more electricity, and so the dynamo builds up the electric current till the safe maximum capacity of the machine is reached. There is no limit to the amount of electricity which can be generated by the dynamo machine within the strength of the materials to bear the strain and conduct away the electricity in safety. By varying the proportions and quantity of iron in the field magnets and the armature, the sizes of the wire with which they are wound and the speed and power with which the armature revolves, the electricity generated may be controlled, from the mildest current, which would not injure a babe, to those terrible manifestations of energy which rival the lightning in velocity and power, not for an instant only, but which obey the bidding of man in the performance of continuous work. Practically, at the present time, individual dynamos are confined within the limits of one hundred horse power, although they can be made of much larger capacity. It is the common practice to have the current of electricity from several dynamos upon the same system of conductors in connection with electric light and power service. There is a goodly number of such stations where one thousand horse power of electrical energy is daily distributed for use in lights and power.

When we come to generating electricity by means of galvanic batteries we find substantialy the same thing to be true, viz., power is converted into electricity.

The energy stored in the metals is set free by a species of combustion caused by the acids, and it is converted into electricity. Again electricity, which is a force, when present in one body, may act inductively upon another and excite electricity therein, but in doing so a portion of the originating force is absorbed.

There is inseparably associated with each atom of matter a fixed amount of force. The atom could not be in the condition in which we found it without the force.

(To be continued.)

1 Read before the Hyde Park Lyceum. Feb. 6, 1888.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the cooperation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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National Electric Light Association.

There has been no material change in the programme of traveling arrangements, outlined last week, for members of the delegation from Chicago, who will attend the National Electric Light convention, at the Monongahela house, in Pittsburgh, Pa., Tuesday, Wednesday, and Thursday of next week. It will be well, however, to recapitulate the arrangements.

The delegation from Chicago will lunch at the Chicago Electric club rooms, 122-124 Clark street, Monday noon, February 20th.

Those who have not already notified George S. Bowen, of Elgin, Ill., or the WESTERN ELECTRICIAN, of their intention of going to the convention, will please send their notifications at once to the WESTERN ELECTRICIAN office, in order that berths in the sleeper may be reserved for them. The prospect is that the delegation will be large enough to fill one sleeper.

The train will leave the Union depot, at Madison and Canal streets, on the Pittsburgh, Fort Wayne & Chicago railroad, Monday afternoon, February 20th,—whether at 3:15 or 5:30 o'clock, is a question still left open.

A PROPOSITION has been received from an electric light company by the Chicago municipal authorities to light the streets at bare cost as estimated by the controller, and pay into the city treasury 2½ per cent of its gross earnings. The matter has been taken under advisement, and if the proper guarantees are furnished, and the city can be assured of the company's responsibility, the proposition may be accepted.

THE plain, simple, non technical lecture of Mr Bliss before the Hyde Park lyceum, a portion of which was published last week and another portion of which is given in this issue, will be read with interest by those whose vocations are in special applications of electricity. The lecture was designed for the entertainment and instruction of those to whom the various applications of electricity are mysteries and for its scope and clearness, combined with instructiveness is to be commended.

REFERENCE will be found on another page to the recent discovery of records of magnetic declination dating back 174 years. Most of our readers are familiar with the fact that the meridian of no declination, in which the magnetic needle points due north and south is subject to constant change of position to the east or west, slowly moving for several years in one direction and then in the opposite; and that at all points to the east or west of this line the needle declines towards the line, the declination increasing with the distance from zero to 24°. This declination was first made the subject of practical observation by Columbus in 1492, and it has been ascertained that about 320 years are required for this movement to accomplish a complete cycle, from the time the meridian leaves any given position till its return to it again. Hence observations dating back to remote periods are highly important, if reliable, in obtaining accurate results and correcting discrepancies.

AT this time, when the alternating current system of electric lighting is receiving great attention, the description and illustration of the new candidate for favor, so brilliantly shown on other pages, will command close perusal and inspection.

Mr. Slattery, the originator of the system, is well known to electric light men. He has devoted years to the development of the system, and, as will be seen from the illustration, has produced a system remarkable for mechanical execution and close care for details.

Stress is laid upon the point that, instead of attempting to combat certain laws which govern the action of inductoriums, attention has been turned toward utilizing them.

The dynamo is after the Lontin type, and is separately excited.

THE question where the midsummer convention of the National Electric Light association will be held is being agitated. Chicago, New York, Cleveland and St. Louis are bidding for the honor. It seems to us that the east, inasmuch as last August's convention was held in Boston, should forego its claim to next summer's convention in favor of the west; this leaves three western cities, Chicago, Cleveland and St. Louis in the race. There is no doubt that St. Louis members of the association would give the convention a royal welcome, for they are royal entertainers, but candor compels the statement that St. Louis in summer is — well, there is a number of northern cities much cooler. The choice then should be between Chicago and Cleveland. Both are easy of access; both are cool; both are in the west. But in respect to hospitality it must be conceded that Chicago outstrips Cleveland, because better entertainers than Chicago members of the association cannot be found. However, Chicago has had the convention once and Cleveland has never had it. Therefore, if Cleveland lays stress upon this point Chicago will have to yield with the best grace possible and claim its right to a future convention. But, at any rate, the choice of the convention should be a western city.

THE postal telegraph is before congress, and the pro and con with reference to its adoption has been ably argued before the senate committee by the opposing factions, those opposed to it urging the annual deficit which it entails in Great Britain, and arguing that the greater area in proportion to population in the United States would entail proportionately greater expense, and that it is unjust to tax the many for the convenience of the few who use the telegraph. It is noticeable that this line of argument, which originates with the leading telegraph companies, seems to be indorsed to some extent, at least, by the southern press. It is well known that the principal financial deficit in the mail service has always been in the south, on account of the comparative illiteracy of the masses there, while in the north the service has been well sustained, and it is reasonable to suppose that the same would be true to a certain extent of a postal telegraph service. This southern deficit was for years the great obstacle to the introduction of cheap postage in this country long after its practicability had been fully demonstrated in Great Britain. While larger area in proportion to population in this country as compared with Great Britain, is a sound basis of argument, it can not be denied that the average standard of intelligence and education among the masses is much higher in our northern states than in Great Britain, and that cheap telegraphy, like cheap postage, would lead to a greatly extended use of the telegraph in such a community. So that in taking the British deficit as the basis of our calculations, great allowance must be made for this difference between the two countries.

THE equipment of the University of Michigan, at Ann Arbor, Mich., for the purpose of providing students ample facilities for acquiring theoretical and practical knowledge of electrical engineering, receives brief mention on another page.

There never was a greater call for young men educated in the principles underlying the applications of electricity, than at present. While the shop has graduated some of the leading electricians of the world, and while its education is not to be decried, it can not be said to be the best school for a young man. Bluntly stated, the shop owner cares but little for the general education of an employe, preferring for him an education in a special line, that will enable him to turn out more work in a given time than another employe. The tendency of the times also is toward large aggregations of capital for conducting a general business, or a confinement of attention to some special line of business. In any case, the employe's education must be circumscribed, and any general education must be gained from other sources than shop practice.

There is need for such institutions as the University of Michigan, Cornell, Massachusetts Institute of Technology, and other large institutions of the kind. At such places of learning the student becomes familiar with the primary principles and sees their application in practice. After such a course, he is well fitted to follow the special branch to which his taste and opportunities incline him.

It is particularly gratifying that at Ann Arbor such extended facilities have been provided for pursuing a course in electrical engineering, and, we may add, that as an able a man as Professor H. S. Carhart, whose name will be recognized as an occasional contributor to the columns of the WESTERN ELECTRICIAN, is in charge.

WE are much pleased to notice that in accordance with an engagement entered into by the Spanish government at the international congress of electricians, held at Paris in 1881, two telegraph wires are about to be laid in Spain for the express purpose of making observations on earth currents and on atmospheric electricity. One of the lines will run due north and south, and the other due east and west, each line being eight kilometers in length. They will cross each other at the astronomical observatory of San Fernando.

This is a subject in which all electricians are deeply interested. The relations between the electricity of the earth and that of the atmosphere are imperfectly understood, and the object of these observations is to furnish accurate scientific data on this important subject. Observations of this nature over the ordinary telegraph lines are subject to constant interruption by the demands of business, and hence strict scientific accuracy is an impossibility, though approximate results have been obtained, sufficient to demonstrate the correctness of recent theories.

It is requisite that lines for this purpose should not only be free from all interruption, so that observations can be made regularly at stated periods, but that they should be exactly on north and south, and east and west lines.

The object is to demonstrate the existence of electric earth currents, to measure them accurately to show the causes which produce them, to show their variations at different hours of the day and night, and at different seasons of the year, and the causes which influence these variations; and to show the inductive relations which exist between these currents and the electricity of the atmosphere, especially as shown in the disturbances observed on telegraph lines during the prevalence of auroras, known as "electric storms."

The imperfect observations made on telegraph lines indicate that these earth currents on east and west lines are due to differences of electric potential caused by the alternate heating and cooling of vast areas of the earth's surface during its diurnal revolution. At the same time the permanent difference of temperature between the equatorial and polar regions, and the alternate movement of zones of temperature to the north and south during the earth's annual journey round the sun are believed to give rise to north and south currents, both in the earth and atmosphere, which by mutual induction produce the aurora.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number xxx.

The Incandescent Lamp.—While the arc lamp is well adapted for lighting large areas requiring a powerful, diffused light, similar to sunlight, and hence is suitable for outdoor illumination, and for work-shops, stores, public buildings and factories, especially those where colored fabrics are produced; its use in ordinary dwellings or for a desk light in offices is impractical, a softer, steadier, and more economical light, being required. Various attempts to modify the arc light by combining it with the incandescent were made in the earlier stages of electric lighting, among which was the sun lamp already described; besides this Reynier's lamp, invented in 1877, was the most successful. Its construction is briefly as follows:—

Reynier's Lamp.—A carbon rod impinges on the circumference of a circular block of carbon which has a rotary motion on its axis. The rod, 12 inches long and $\frac{1}{12}$ of an inch in diameter, is attached by a horizontal support above to a brass holder which has a free vertical motion in a brass tube placed on a level with the carbon block, and by its weight keeps the rod as it is consumed in contact with the block. The rod is guided in its descent between a small copper roller on one side and a short pointed carbon on the other, the current entering the rod through this point at about $\frac{1}{4}$ of an inch above its contact with the carbon block, so that this short portion becomes incandescent and produces the light. A brake connected with the carbon-holder and block by a horizontal support regulates the descent of the carbon rod, and the rotation of the block, produced by the pressure of the rod as it descends and is consumed, removes the ash and slag. A rod lasts about two hours, and furnishes a light of 114 to 150 candle power. But the ratio of light produced to electric energy consumed does not exceed $\frac{1}{6}$ of that produced by the arc light, and the carbon rod is liable to break and extinguish the lamp.

Various improvements in this lamp have been attempted, such as the substitution of a copper block for the carbon block, also of shorter and thicker rods, less liable to fracture, and of several rods lighted automatically in succession, also of springs or clockwork for gravity in maintaining the contact of the carbons; but none of these semi-incandescent lamps have come into general, practical use, though their efficiency in proportion to electric energy consumed was greatly increased above that of the Reynier lamp, so that an efficiency three times as great in proportion to consumption of energy as that of the strictly incandescent lamp, is said to have been attained; and it is possible that such efficiency may ultimately be attained as to bring this system into general use.

The first strictly incandescent lamp was invented in 1841 by Frederick de Molyens of Cheltenham, England, and was constructed on the simple principle of the incandescence produced by the high resistance of a platinum wire to the passage of the electric current. In 1849 Pétrie employed iridium for the same purpose, also alloys of iridium and platinum, and iridium and carbon. In 1845 J. W. Starr, of Cincinnati, first proposed the use of carbon, and associated with King, his English agent, produced, through the financial aid of the philanthropist Peabody, an incandescent lamp having 26 lights, which attracted the attention and excited the admiration of Faraday. The advantages of carbon over platinum consist in its greater electrical resistance, which is 250 times that of platinum, its absolute infusibility even at very high temperatures, its lower thermal capacity by which the same amount of heat produces a much higher temperature, and its greater illuminating power at the same temperature as platinum.

In all these early experiments the battery was the source of electric supply and the comparatively small current required for the incandescent light as compared with that required for the arc light was an argument in favor of the former, twelve Bunsen elements being sufficient to produce twelve incandescent lights in one circuit as demonstrated by DeChangy, of Paris, in 1857, while twenty-four to forty elements were required to produce a single arc light. Still no substantial progress was made with either system till the invention of the dynamo resulted in the practical development of both systems, that of the incandescent following that of the arc.

Among the first to make incandescent lighting a practical success were Sawyer & Man, of New York, and Edison. For a long time Edison experimented with platinum, using fine platinum wire coiled into a spiral, so as to concentrate the heat and produce incandescence; the same current producing only a red heat when the wire, whether of platinum or other metal, is stretched out. A metal rod placed inside the coil, was so arranged that when the temperature approached the point where the coil was liable to fusion, the expansion of the rod closed a short circuit, which reduced the current and consequently the temperature; the contraction of the rod produced by the cooling, opened this circuit, and increased incandescence followed.

Failing to obtain satisfactory results from platinum, Edison turned his attention to carbon, the superiority of which as an incandescent illuminant had already been demonstrated; but its rapid consumption, as shown by the Reynier and similar lamps, being unfavorable to its use as compared with the durability of platinum and iridium, the problem was, to secure the superior illumination of the carbon and reduce or prevent its consumption. As this consumption was due chiefly to oxidation, it was questionable whether the superior illumination were not due to the same cause, and whether, if the carbon were enclosed in a glass globe from which oxygen was eliminated, the same illumination could be obtained. Another difficulty of equal magnitude was to obtain a sufficiently perfect vacuum and maintain it in a hermetically sealed globe inclosing the carbon, and at the same time maintain a electric connection with the generator through the glass by a metal conductor, subject to expansion and contraction different from that of the glass, by the charge of temperature due to the passage of the electric current. Sawyer & Man attempted to solve the problem by filling the globe with nitrogen, thus preventing combustion by eliminating the oxygen and at the same time maintaining a pressure equal to that of the external atmosphere, so that the leakage by the expansion and contraction of the metallic conductor would be insignificant.

The results obtained by this method, which at one time attracted a great deal of attention, were not sufficiently satisfactory to become practical, and Edison and others gave their preference to the vacuum method, and sought to overcome the difficulties connected with it. The invention of the mercurial air pump with its subsequent improvements made it possible to obtain a sufficiently perfect vacuum, and the difficulty of introducing the current into the interior of the globe, was overcome by imbedding a fine platinum wire in the glass, connecting the inclosed carbon with the external circuit; the expansion and contraction of the platinum not differing sufficiently from that of the glass, in so fine a wire as to impair the vacuum.

Incandescent Light Carbons.—The next point of greatest importance was to obtain carbons of the proper consistence, tenacity, and durability, and this, as in the case of arc light carbons, required a long series of delicate and costly experiments with a variety of materials, treated by a variety of different processes. The carbons made by Edison under his first patent in 1879, were obtained from brown paper or cardboard, cut into narrow strips in the form of a horse shoe, which was about $2\frac{1}{4}$ inches long and $1\frac{1}{2}$ inches in diameter. These were reduced to carbon in an iron mold placed in a muffle, and maintained at a high temperature. They were very fragile and short lived, and consequently were soon abandoned. In 1880 he patented the process which, with some modifications, he still adheres to. In this process he uses filaments of bamboo, which are taken from the interior, fibrous portion of the plant. The cane, after being cut into sections of the required length, and the hard outer surface removed, is split and shaved down into flat strips, which are then pressed between dies, and fine filaments of the required length and diameter obtained. These are placed in molds made of nickel, in grooves of the required horse shoe form, and closed so as to exclude the air. The molds are then placed in muffles, and the filaments carbonized at a very high temperature. They are then attached to their platinum wire supports, by electro-copper-plating, and introduced into the little lamp globes. The lamp is then attached to a Sprengel air pump, and during the process of exhaustion the filament is alternately heated and cooled by an electric current; the temperature being gradually raised by increase of current after each cooling, till a high degree of incandescence is attained. This removes all the occluded gases which remain after the carbonizing, and renders the carbon homogeneous, elastic, and refractory at a high degree of temperature. As this is a far more severe test than any to which the carbon will be subjected in use, all imperfect and defective carbons are destroyed in the process, and only the best survive.

Electricity and Sewage.

Electricity, which has served so many purposes in science and in the arts, now promises to rescue civilization from one of the most pressing difficulties which beset it. The metropolitan board are about to expend a sum of nearly or quite a million sterling in purifying the London sewage, so that the Thames shall be delivered from its present state of pollution. The process to be employed is of a chemical nature, and enormous works for the purpose of carrying out the project are in course of construction at Barking, to be followed by others of a similar nature at Crossness. At this juncture a plan of an entirely novel character is being perfected, which has the appearance of dealing successfully not only with the whole sewage problem, but also to a large extent with the question of water supply of towns. The plan has been devised by William Webster, F. C. S., son of the well-known contractor who has had so large a share in executing the drainage works of the metropolis. For certain reasons connected with the patent office, it would not be fair to the inventor to enter at present into all the details of his process, but certain results can be stated which will establish the importance of the undertaking. A current of electricity, produced either from cells or from a dynamo, is sent into the sewage, the transmission being effected through metallic electrodes. Instead of casting chemical ingredients into the sewage, the inventor adopts the plan of creating his chemicals in the sewage itself by the action of the electric current on the electrode and on the sewage. The effect is curious and is well seen when the liquid is exposed to view in a glass vessel. An inky fluid, obtained from the Deptford pumping station of the metropolitan board, has all its particles set in a circulatory motion by the electric current, a kind of procession taking place from the top downwards and from the bottom upwards. The sum total of the movements consists in landing the suspended particles at the top of the liquid, thus exactly reversing the usual chemical process, which sends everything down in the form of a precipitate. The upward action is due to the presence of certain gases, at first extricated by the electric current and afterwards mingling with the organic matter so as to give buoyancy to the latter. By agitating the liquid the gases can be sent off into the air, and the solid particles will then descend to form a precipitate, showing no tendency to permeate the fluid as before. But, as will be shown presently, there is no need to effect this precipitation. So prompt is the effect of the electric current that in the space of twenty minutes a volume of opaque sewage becomes perfectly transparent, except at the top, where the organic matter collects in a semi-solid form. A sample which we saw thus treated presented at the close a somewhat milky aspect, apparently due in a large measure to the presence of chalk, the Deptford sewage being impregnated with the water supply of the Kent company, derived from deep wells in the chalk formation. Some portion of the cloud might also be occasioned by suspending clay. But the tint was slight, and the contrast exhibited before and after treatment was of a most striking character. It should be added that no offensive odor was perceptible.

It is claimed for this process that it effects the removal of all the solids in suspension in the sewage, and also the greater part of the matters in solution. In actual practice on a working scale, the separated portion floating at the top of the sewage can be run off by one channel and the clear water beneath by another. W. Webster has carried his experiments beyond the mere bounds of the laboratory, but is anxious for a more extended test, so as to establish the character of his process beyond a doubt. Of course, the element of finance comes in. For this purpose certain data are already available, and these are so far of an encouraging nature. From the results already obtained, it is calculated that the cost of the electric current for treating the entire volume of the London sewage, north and south, would be about £25,000 per annum. This sum represents the working expenses, and compares with the cost of the chemicals employed by the metropolitan board in their treatment of the sewage. The annual outlay for chemicals when the plant comes into full operation is expected to be £18,000 for lime and iron, and £12,000 for permanganic acid, thus making a total of £30,000 per annum. According, so far as estimates go, there is a balance in favor of the electric method. But in the latter instance there is the advantage of a purer effluent, as also of a quicker process. It may be asked, what is to become of all the expensive works now in course of construction at the Barking outfall if the chemical method is at the last moment to be superseded by another of an entirely different character? Is the contract sum of four hundred and six thousand pounds to be absolutely thrown away? Happily, the contingency is not quite so bad as this. Mr. Webster's plan, after all, is partly chemical in its action, only it happens that the chemical process is set up by the electric current. Tanks will be required for the reception of the sewage, and much of the Barking plant will be of service in connection with the new process. The most urgent question is that which has reference to Crossness. The tenders for the works at that spot have not yet been invited, but the plans are understood to be complete. If the electric method is discovered to be preferable to the chemical, the Crossness works ought to be constructed in strict conformity with the requirements of the former. A peculiar feature to be contemplated is the very small addition which the electric method makes to the solid residuum. No chemicals are introduced into the sewage, except small quantities thrown off from the electrodes. This may be reckoned at a grain per gallon, amounting, in the immense volume of the London sewage, to ten tons per day. But the chemical method requires, rather more than three and a half grains of lime and one grain of proto-sulphate of iron, besides the permanganic acid. The lime thus represents thirty-seven tons per day, and as the solids in the precipitated matter are always accompanied by an enormous quantity of water, every ton added to the former is multiplied in the quantity which has to be dealt with in the form of "sludge." There will, therefore, be much less to remove in the semi-solid form by the electric method than by ordinary chemical treatment, although the former extricates all the solids in suspension. To remove the sludge produced by the chemical plan hitherto approved, the metropolitan board contemplates building five steamships, costing £16,000 each—one being already afloat—unless in the meantime the farmers show a disposition to receive the sludge for the purpose of fructifying their crops. The sludge produced by the electric process will have the advantage of possessing some of the ammonia previously held in solution, and will be so much the more valuable.

Mr. Webster's electric plan for the treatment of sewage has already been exhibited in an experimental form to Sir Joseph Bazalgette and W. J. Dibdin, the latter being the chemist to the metropolitan board. Other scientific authorities have also seen the experiments, and enough has been demonstrated to gain for the new process a respectful consideration, if not something more. In all probability the metropolitan board will proceed at once to inquire into the merits of this remarkable process. All may be said to depend on its financial aspect. It may be considered a proved point that electricity can be made to effect a perfect purification of sewage. If Mr. Webster fails anywhere, it will be in the question of cost. The working expenses may have been correctly calculated, but interest and redemption of capital must also be taken into account. Steam engines will cost a large sum, and dynamos are expensive, although doubtless capable of being cheapened. With respect to the question of the water supply, Mr. Webster has applied his plan with great success to the purification of water intended for drinking purposes. The filtration of the metropolitan supply costs the London water companies at the present time nearly sixteen thousand pounds per annum. It will be a singular transformation if the filter beds should be superseded by an array of electrodes.—*London Standard.*

New Insulated Wires.

Recognizing the need of a reliable insulated wire for high or low tension currents in other than underground work, the Standard Underground Cable company, of Pittsburgh, Pa., are now making an excellent weather-proof line wire, the fibrous covering of which is treated with their well-known insulating material, "ozite" and water-proof paint. This wire is a substitute for underwriters' wire, either as a line wire or for use in buildings. Fig. 1 is an illustration of the wire, actual size, number 1, B. & S. gauge.

As showing the quality and use of this Standard weather-proof wire, the following from the Pittsburgh *Dispatch* of January 29th is to the point: "At the East End Electric Light company's plant the wires extend from the station

FIG. 1—STANDARD WEATHER-PROOF WIRE.

FIG. 2—"W. A. C." WIRE.

on Broad street to Edgewood station on the Pennsylvania railroad, a distance of four miles, making, with the return wires, an eight mile circuit. The wire used, which is requisite to such a test, is known as Standard weather-proof wire of number 4 B. & S. gauge, and was manufactured by the Standard Underground Cable company, of this city. The current flowed without any interruptions whatever, and no leak could be discovered in the line at any point."

The line referred to had been exposed to rain, frost, snow and thaws for nearly a month prior to the test.

Another style of insulated wire now made by the same company is its "W. A. C." fire and water-proof wire, for use in damp places, in cellars, or in plaster walls, or as line wire. This wire is shown by Fig. 2, actual size, number 0., B. & S. gauge. It is heavily insulated by successive layers of fibrous material thoroughly saturated with a special water-proofing compound, and is provided with an outer coating of fire-proof material, making altogether one of the best insulated wires in the market.

Such is Fame.

In the telephone field there probably is no name more widely known in connection with switch board appliances than that of Charles E. Scribner, of the Western Electric company of Chicago. His inventions are well nigh without number, and his name in connection with patents granted is very frequently seen. One of Mr. Scribner's earliest, as well as most important inventions, was styled the jack-knife switch—a switch very familiar in telephone exchanges of the earlier days, and every telephone man knew by reputation, at least, Scribner, the inventor of the jack-knife switch. This is American history. Here comes French history, as set forth in a work entitled *Dictionnaire Theorique et Pratique d'Electricite et de Magnetisme*, now being issued in Paris. Describing the jack-knife switch, the article runs: "This name was given it because, at the start, the contact spring was arranged like a knife blade, and because the invention was due to a French Canadian named *Jack*."

Great Scott! is such fame?

Sunstroke by Electricity.

In the *Journal des Debats*, M. Henri de Parville gives an account of some extraordinary medical observations on electric sunstroke, collected at the famous French foundry, Creuzot.

Ordinary sunstroke we all know. But there is another kind of sunstroke indefinitely more strange, yet scarcely known, and that is the electric sunstroke. Now, what is electric sunstroke? Dr. Defontaine, in his character of head physician at Creuzot, has been called upon to examine its effects. It is already known that electricity is employed in the form of an intense focus [foyer] to smelt certain minerals, and especially to melt and solder metals. Thus a metal placed in the electric arc is fused as if by magic. Steel melts like butter in a few seconds. Now Creuzot, where the progress of science is followed step by step, has for some time possessed its electric furnace. Steel is soldered directly by the high temperature produced by electricity. The electric arc in which the metal is placed is of marvellous radiance. Its luminosity focus upon a few square inches exceeds 10,000 Carcel lamps and surpasses 100,000 candles.

It happens that spectators standing at a distance of, say, ten yards feel no heat; but presently they become conscious of acute pain. "Very odd," said a bystander, "I feel no heat, but I have a sense of being burnt which recalls the sunstroke I had last summer." Therefore he stood off, but not before he had in fact experienced something like a second sunstroke. It almost always happens that, after an hour or two, persons witnessing the experiments feel a burning sensation, with more or less pain, in neck, face, and forehead, and their skin at the same time assumes a coppery red tint. It is customary to protect spectators' eyes with blackened sun glasses; yet their retina is affected to such an extent that blindness supervenes in broad daylight for several minutes, and for nearly an hour all objects are seen in deep saffron color. Other symptoms are headache and sleeplessness. Afterward the skin of the face gradually peels off in broad flakes, when the complexion is left of a fine brick color. This we take to be the description of severe cases.

In ordinary sunstroke it is reasonable to attribute the sun's share to heat, if for no other reason than that the solar heat is felt. But here there is no sense of heightened temperature. Nay, a thermometer placed within five yards of the arc which is melting steel like butter, is hardly affected at all. All the heat seems to remain concentrated: and while at five yards' distance the thermometer hardly moves, bystanders suffer stroke even at fourteen yards. To what else can we appeal, therefore, but to light pure and simple? The fact is interesting in many ways, but it illustrates once more the active part played by light in a variety of biological phenomena. It may now be asked: is the skin affected by the red and yellow rays of light, or is it not rather to the chemical rays, the violet and purple rays, we should look? M. de Parville inclines to the latter hypothesis. M. Defontaine is silent; but M. de Parville thinks that by trying the alternate effects on the skin of the red and yellow rays and the violet rays, respectively isolated, the problem may be capable of easy solution.

The *St. James Gazette* after publishing the foregoing gave place to the appended communication on the subject from H. P. Malet: You

have an important notice of this action in your issue of yesterday, by which it is shown that great heat can be produced by focussing an electric light "of marvellous radiance;" that people standing near "feel no heat," but have a sense of "being burnt," and suffer pain similar to that of a sunstroke. You attribute this action to "light pure and simple." It has already been said on this subject: "There are many facts in natural philosophy which show that heat is produced by the sun's rays only when they act on a calorific medium." Hence a man on a glacier three miles above sea level gets his face burned by sunlight, while the ice at his feet does not melt. The same authority shows "that the solar focus of the largest lens, thrown into the air, will occasion no sensible heat," although it causes combustion when certain bodies are exposed to its action. "Sunlight," just published by Messrs. Treubner, points out the confusion of science as to heat and light, and suggests a consideration as to light pure and simple being the cause of action in all gases and material sensitive to and absorptive of light. If the supposed chemical rays of the sun can be isolated, and if they show different effects on the same subject, then the point may be reconsidered, at present we may conclude that the varied heat of earth-matter under one general sunshine is the result of the same action as the record of the electric light.

Newly Discovered Records of Magnetic Declination.

Charles A. Schott, assistant in charge of the computing division of the Coast and Geodetic survey, has addressed a letter to the superintendent of that bureau which states that the discovery of records of the magnetic declination, A. D. 1714, off the coast of Mexico, by Assistant G. Davidson, and transmitted by him to this office, Dec. 7, 1887, proved to be a matter of much importance by greatly increasing our knowledge of the secular variation of the declination. By means of these observations we are able to improve materially the expressions for San Blas and Magdalena Bay, to add the new station Cape San Lucas, and to make their influence felt as far north as San Diego and Santa Barbara. It is the range which is greatly improved; besides, the epoch of maximum declination is shifted in the right direction. Apart from the fact that a region of west declination is here for the first time observationally indicated on the Pacific coast, the power of the newly recovered declinations is due to the circumstance, that, as far as known, they cover a time when the needle was in or near a phase the opposite of the present one. For want of early observations, these previously collected for San Diego and Santa Barbara, Cal., were extremely difficult to handle; and, while it was not an easy matter to establish new expressions for these stations, their correctness, or rather applicability over the whole period of time the observations cover, is quite re-assuring. He points out the desirability of new observations—either using funds yet available before July next, or providing funds to be used after that date—at San Diego, Santa Barbara, and Monterey, and states that these stations have received no attention for seven years. These observations are demanded to give greater precision to the computed variations on our charts.—*Science.*

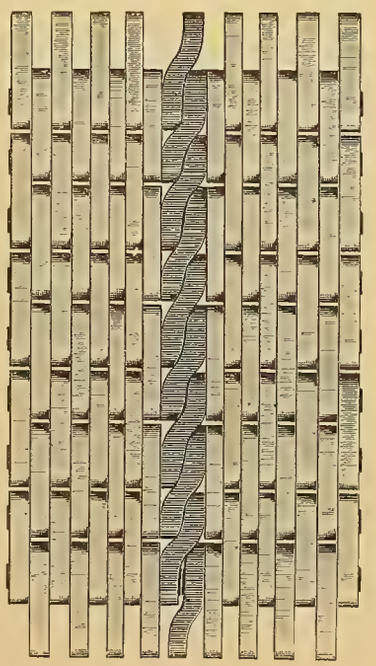
Leather Link Belting.

Leather link belting was first introduced into this country some two years ago by Chas. A. Schieren & Co., of New York. In England these belts are used almost exclusively on dynamos. English link belts are made with one continuous bolt for each width of belt, and can be run on flat faced pulleys only, whereas belts made by the foregoing firm have two bolts for each width of belt, which are ingeniously joined in the center as shown in the illustration. These belts can be run on any pulley, whether flat, round or cone, and are bound to give perfect belt contact. Their chief advantages are that they impose less strain upon the dynamo bearings, and consequently do away with heating, and reduce the use of oil. They are generally run under little or no tension, and the vibration due to different atmospheric conditions ceases therefore to be of consequence.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 11.—Forty years ago, on the 5th of February, W. W. Marks, well known as superintendent of the Bishop Gutta Percha company, began in Brooklyn his work of manipulating and preparing gutta percha for the market for various purposes, and through all these forty years, he has, without interruption or cessation, given his time and attention to this important article of commerce. Prior to 1848 he was engaged in the manufacture of India rubber fabrics. The gutta percha business requiring larger capital and facilities for manufacturing, the Bishop Gutta Percha works were organized, Mr. Marks being retained as superintendent. Then gutta percha was used principally for pipes, bottles for chemical fluids, and shoe soles. But attention being called to its electrical properties following the discoveries of Faraday, the Bishop works took hold of the insulated wire and cable business, and in this field Mr. Marks' inventive skill accomplished the largest results. He designed machinery for making cables and covering wires for every electrical purpose, and he personally superintended the laying of sub-marine cables. During the war of the rebellion he made and laid cables for the government, one being twenty-five miles in length, across Chesapeake bay.



LEATHER LINK BELTING.

For thirteen years following the death of Mr. Bishop, and prior to the incorporation of the present company, Mr. Marks had sole control of the business. One of his inventions, and a most valuable one, is the "Marks' compound," an insulation which resists the action of acid and which is used almost exclusively for battery wires. Mr. Marks claims the honor of having been continuously employed in the insulated wire business for a longer period of time than any other person in America or Europe.

The Western Union Telegraph company are again at Albany asking for the return of taxes wrongfully exacted from them seven or eight years ago. The state owes the company some $200,000, and there seems to be no question about the justice of the claim, but for some reason or other, possibly because the Western Union Telegraph company is too virtuous to pay for legislation, the bill has not yet been collected.

General H. S. Huidekoper, vice-president and general manager of the Metropolitan Telephone and Telegraph company, resigned this week and W. H. Eckert was elected general manager in his place. Mr. Eckert has been general superintendent of the company and his promotion gives universal satisfaction.

The Electric Accumulator and Lighting company has been organized, with headquarters at Bridgeport, and has secured the franchise from the Electric Accumulator company, of New York, for the state of Connecticut. Fred. M. Mason has been chosen president of the new company.

M. F. Cushing, superintendent of repairs of the New York and New Jersey Telephone company, was married to Miss Mamie F. Kinney on Wednesday afternoon, at St. Agnes church, Brooklyn.

More mystery from the "Wizard of Menlo Park." A daily paper states that Professor James Ricalton will start traveling for Edison this week, searching for a new substance which, if it can be found, will revolutionize the applications of electricity to modern uses. Mr. Edison is said to have samples of the substance, but he does not know where it is to be found, and Professor Ricalton goes to find out. A.

From Topeka, Kan.

TOPEKA, KAN., Feb. 11.—Thursday evening last the city council settled the vexed question as to which electric light company should have the contract for furnishing the city plant, by awarding it to the Jenney Electric company of Indianapolis, Ind. The various bids were as follows:

Brush Co., with high speed engines	$24,925
Brush Co., with low speed engines	25,140
Guaranteed limit of cost of lighting per annum:	
For all night, every night	10,080
By moonlight schedule	9,640
Indianapolis Jenney Co, high speed, two 12x12 Ball engines	26,496
Low speed engines	27,430
Guaranteed limit of annual cost:	
All night lighting $8 for light per night	11,520
Moonlight schedule $6 for light per night	8,640
Thomson-Houston Co.	
With high speed engines	26,950
With low speed engines	27,775
Guaranteed limit of cost of running:	
All night	7,000
Moonlight schedule	4,800
Western Electric Co., high speed engines	23,210
Annual cost exclusive of coal:	
All night	4,300
Moonlight schedule	3,800
Schuyler Co., with high speed engines	24,663
With low speed engines	25,091
Cost of running:	
All night	7,700
Moonlight schedule	5,500

The published proposal of the successful bidder reads substantially as follows in regard to the electrical portion of the plant:

"We will furnish four arc dynamo electric machines of sufficient power to sustain 30 arc electric lamps of 2,000 standard candle power each, with ample reserve capacity. These dynamos to be of the Jenney system and to embody all of Mr. Jenney's latest improvements, including his improved brush adjuster, copper commutator with mica insulation, universal boxes, foundation frames, improved belt tighteners and automatic current regulators for each dynamo. The latter renders the dynamo perfectly automatic, maintaining constant current. We will also furnish four ammeters or current indicators, four lightning arresters to protect the system from electrical discharges, and one magnetic bell for testing the circuit. We will furnish a complete plug switch board for four circuits, so arranged that each dynamo can be connected with any circuit, and so that any two machines can be connected in series with any two or more circuits.

"We will furnish one extra armature as required in your specifications.

"We will furnish one hundred and twenty all night lamps of 2,000 standard candle power each, of the double carbon pattern. These lamps to be automatic and self-regulating to, have automatic cut-out, switches, hood sand globes, and to be of the Jenney system with all the latest improvements. These lamps will produce a clear steady light, free from sparking and fluctuations.

"We will furnish the necessary poles for seventeen miles of circuit, said poles for carrying the line to be thirty feet and forty foot poles for suspending 120 lights.

"The lamps are to be suspended from galvanized steel suspension cable strand, stretched taut from pole to pole.

"We will furnish such number as you wish, of our improved mast arms for holding the lamp not less than thirty-five feet from the ground, the arm extending twenty-three feet from the standard, and adjustable at an angle of forty-five degrees, if desired, thus allowing greater elevation of the lamp. Price $30 each, in place.

"We will furnish twenty-two miles of number 5 B. and S. gauge electric light line wire.

"The bid for the poles and wire is estimated on seventeen miles of poles and twenty-two miles of wire, and should there be any addition or reduction from either, it will be charged for or deducted at the rate of $450 per mile for the wire and poles, or $180 per mile for the wire alone.

"We will furnish thirty days' supply of one half by twelve inch carbons, suitable for our system.

"We will furnish any additional dynamos and lamps that you may require from time to time, at a discount of 30 per cent. from the price list which is hereto attached, or at the lowest prevailing prices when such purchases are made.

"It is understood that anything omitted in this proposition that may be necessary to make the installation complete and operative, will be furnished as though the same had been herein fully described. When the plant is complete and ready to operate, we will run the same for a period of ten days, the city furnishing the fuel. We will also furnish an expert for thirty days from the starting up of the plant, to instruct the employes how to run the same most economically and efficiently. We further guarantee a good and sufficient title to use the apparatus herein mentioned, and will furnish a bond of indemnity in in support of this guarantee.

"We further agree, if this proposition is accepted by your honorable body, to prosecute the work vigorously until completed. When the plant is accepted you are to pay us, under the proposition for the power plant with high speed engines, and electrical outfit as herein described, the sum of $26,196. If our proposition with Corliss engine is accepted, you are to pay us for the power plant and electrical outfit as herein described, the sum of $27,430. Payments to be made upon such terms and conditions as may hereafter be agreed upon.

"We guarantee and will furnish a bond satisfactory to you, that the entire cost of supplies, ordinary repairs, and operating said plant of 120 lights shall not exceed the sum of $6 per light per month, for a period of two years from date of lighting, based on the present price of fuel, labor and supplies, and conditional that the control and management of the plant shall be under our control or subject to our approval. The lighting under this guarantee to be done upon what is known as the moonlight schedule, and including also such nights as when the moon is obscured by clouds or fogs; and to light only until 1 o'clock, a.m. Or, in case of all night lighting for every night in the year, that the entire cost as above set forth shall not exceed the sum of $8 per light per month for the said period and upon the said conditions." C.

From St. Louis Mo.

St. Louis, Mo., Feb. 4.—George F. Durant, the manager of the American Bell Telephone company of St. Louis, was called before the committee on public improvements of the house of delegates recently for the purpose of giving the committee some information as to the cost of operating a telephone system and the profits. The committee is considering a bill introduced by Delegate Mohan, which fixes the rent of telephones at $50. The present rates are $60, $80 and $100. The manager said in the beginning of his testimony that it would be impossible for the company to supply telephones at the price proposed without losing money. Last year at the present rates the company here on all its lines, made $227,520.60, and paid out $175,606.63, leaving a profit of $51,824.03. The company controlled 3,600 miles of wire and had 2,100 telephones, whose average rent was $97, and average cost for operat ng expenses was $80. Last year the average cost of each telephone was $72.06. The plant in St. Louis had cost $300,000, and the royalties upon each instrument were $20 a year, with a rebate of 30 per cent. The average cost of a mile of wire was $14, and about $5000 a year was paid to the city in taxes. The company had 107 employes, whose pay ranged from $1.75 a day to $140 a month. The telephone girls were paid $40 a month when expert. Beginners were paid $15 a month, and advanced $10 a month at the end of a year if they showed cleverness. If unusually bright, their pay was raised more rapidly. The manager read from a list the prices paid for telephone using by the large cities of the United States. In none of them as large as St. Louis was the price given as less than $100, and in several it was higher. The committee will meet again February 8, and Manager Durant will be called again to describe more in detail the expenses and profits of his business here. C.

From Kansas City, Mo.

Kansas City, Mo., Feb. 11.—This city is proud of its telephone service, and well it may, as in the Missouri & Kansas Telephone company it has undoubtedly the largest and finest managed telephone company in the west. January 25th the annual meeting of the company was held, and a slight change made in the management. The following is the list of officers and directors elected:

J. R. Mulvane, president; C D. Crandall, secretary and treasurer; directors, J. S. Check, W. B. Clarke, C. D. Crandall, J. E. Hudson, J. Lone, J. R. Mulvane, George L. Phillips, J. L. Smith, T. B. Sweet. The city exchange, located in the Wales building, corner of Sixth and Delaware streets, occupies the entire upper floor, and at the present time has 2,350 subscribers. The company employ 125 operators—38 day and 11 night operators being employed in the Kansas City exchange. On January 1, 1887, the company had 5,186 subscribers, and on January 1, 1888, 6,109—an increase of 923 subscribers during the year. They have built 162 miles of extra territorial lines, and paid 6 per cent. dividend for 1887. The average number of calls answered per day in the city exchange is 30,000—the busiest hour being from 9 to 10 a. m., during which time about 3,500 calls are answered; between 10 and 11 a. m., about 3,100; between 2 and 3, about the same number; from 7 p. m. to 12 p. m., about 1,000; and from that time to 7 a. m., about 200. W. W. Smith, the superintendent, has in his office one of the Standard Electric company's clocks, arranged and connected automatically with one of the many switch boards. The clock registers every call the operator makes, so that at any time it can be ascertained how many calls have been made on that board during any specified time. Mr. Smith will soon have clocks connected with each board, which will show the exact number of calls made each hour, or each 24 hours. The arrangement and connection of the above clock was done by Mr. Barrett, the company's electrician. A system is used whereby every call, and the number asked for, is registered, showing how many times each subscriber uses his telephone; also whom he asked for, and whether connection was made with the one asked for. A dash after a call denotes "line in use," so it will be seen on the register, 944 asked for 1,365——meaning 1,365 talking; later 944 asked for 1,365, no dash, showing that subscriber had the connection asked for. This enables the superintendent to talk intelligently with the fault-finding persons that all telephone companies have among their subscribers. For instance, Mr. Johnson calls, and says, "My telephone doesn't work." "What day did you fail to get connection?" "Yesterday." [Manager turns to register.] "Your telephone was used 7 (or 10) times," as the case may be, "yesterday," or "Yes, we find we received no calls from you; will attend to same at once." "What, used 7 times? I didn't use it!" That shows the manager that every one in the neighborhood is using that telephone. The company have now under their control 37 exchanges, and 67 toll stations.

Fort Scott, Kansas, is to have a new electric light company. The company will be known as the Fort Scott Electric Light and Power company; capital stock, $100,000. The following gentlemen composing the company are well known in western business circles as competent financiers and successful managers: C. F. Drake, W. H. Stout, A. W. Walburn, R. J. Harris, C. S. Rushing. They have already selected and secured the grounds for the location of the plant, at a central point in the city. The T-H system, both arc and incandescent, will be installed. The plant will be one of the largest and most complete in all its details of any so far erected in the west, and will add very largely to the manufacturing possibilities of the city.

William Bourn, representing the Hawkeye Electric Light company of Oskaloosa, is in the city, in the interests of his company. D.

THE ELECTRIC LIGHT.

James F. McLaughlin, an electrician of Philadelphia, thus describes a new invention for signalling during time of war. "The scouts or signal officers carry in their knapsacks six small incandescent lights of the different primary colors. These are connected by a very fine wire with a small battery in the knapsack. Attached to the small globes that inclose the lights is a very small oval electric motor, operated by an independent battery. When one scout wishes to communicate with another he sends one globe high into the air and then turns on the electric current that illuminates it. By the use of the different colored globes and by combinations a conversation of any length can be carried on at night at long distances. The invention will be patented in Europe, and an effort will be made to introduce it into the different European armies, as well as into the alleged army in this country."

Sedalia, Mo. already has one electric light plant and the city council has been asked to pass an ordinance granting to certain Sedalia gentlemen the use of the streets and alleys for the erection of posts, wires, etc., with a view of establishing a second electric light plant.

The Santa Fe railroad at Topeka, Kan., are experimenting with the electric light for lighting their trains.

The Springfield, Kan., Light, Heat and Water Works company has been incorporated; capital stock $30,000; incorporators: Ed. A. Watson, M. L. Turner, Theodore Pierce, E. M. Campbell and Joseph Wisbs, all of that city.

The Oswego, Kan., Electric Light company has been incorporated; capital stock $60,000; incorporators: F. L. Greene, C. D. Woodford, C. W. White, Hugh McNellis, C. B. Woodford, all of Oswego.

The Normal Park, Cook county, Ill., Taxpayers' association asked the Town of Lake Board of Trustees that a system of electric lights be established on Halsted street, from Sixty-third to Sixty-ninth streets, and on Sixty-ninth, from Halsted street to Wentworth avenue.

Professor Barrett, city electrician of Chicago has made a proposition to the county board that the city and county unite in running the electric light plants in the court house and city hall. A special committee, will investigate the benefits of such a union.

Carlinville, Ill., started a Brush plant of 65 arc lights on the 10th inst.

The efficiency of the Waterhouse dynamo at the LeRoy Payne stables near Chebanse, Ill., is so great that Mr. Payne thinks of extending the wires some two miles to Chebanse town, and lighting the principal portion of the town.

The London *Electrical Review* of Jan. 27th thus comments on electric lighting in this country: "Six months ago it was reckoned that there were 100,000 arc lamps burning nightly in America, and that the earnings averaged about 40 cents each per evening for, say, 330 nights in the year. This would yield $13,160,000 per annum. Allowing 75 per cent. expenses, this would be $3,290,000 on a capital of about $35,000,000, or not quite 10 per cent. per annum. Probably by the present time the number of arcs has been increased by several thousands. The business in carbons for these alone must be simply enormous in the states. At the same date there were over 750,000 incandescent lamps in use. Would that such progress could fall to the lot of English manufacturers!"

At Boston, Mass., on the 8th inst., the taking of testimony for the complainant was begun in a suit for infringement brought by the Brush Electric company against the Western Electric Light & Power company of Toledo, O. The

point involved is the use of double carbon lamps, and the complainant alleges that the double carbon lamps used by the defendant constitute an infringement upon a patent number 219,218, granted Charles F. Brush, Sept. 2, 1879. L. L. Leggett appeared for the complainant and George P. Barton for the defendant.

The Italian army has introduced the electric light into Abyssinia, Fort Victor Emanuel being lighted by it.

The Western Electric company's plant at Fort Collins, Col., of 45 lights, was started Feb. 10th

Society has to have its reigning "fad" as regularly as the seasons come around, runs a New York letter. It was sadly in need of a fresh one this year until Mrs. D. O. Mills last week brought forth the novel idea of stringing little bulbs of electric lights on a silken cord and hanging them from the draperies and in odd nooks and corners about her rooms. Mrs. Vanderbilt followed, and at her cotillon Tuesday night she had 200 of these little lights scattered through her rooms, and on the dining table three of them were grouped in pyramid shape here and there, each one shedding a different colored ray of light.

One thousand incandescent lights of the Thomson-Houston system are being installed at Fort Scott, Kan.

Colorado Springs, Col., and Pueblo, same state, have just increased their Thomson-Houston plant by fifty arc lights in each instance.

Santa Anna, Cal., and Pasadena, Cal., have each purchased Thomson-Houston plants of fifty arc lights within the last week.

Among the subjects for which the Societe Industrielle of Amiens has offered a prize, is "the best electric light installations in an industrial works." The light must have been in operation for at least a year, and it must be proved to be cheaper than gas made on the premises. Further, the installation must be equivalent to a gas system of not fewer than three hundred jets.

A new carpet factory, at Dundee, Scotland, has just been fitted up with five hundred electric lamps. The dynamo is worked by the engine which drives the looms.

The Abilene, Kan., Electric Light & Water Works company propose to inaugurate improvements in the near future, by the construction of branch works at Sand Springs, three miles west of the city, the water of which will be pumped in and through all the mains in Abilene. The capacity of the springs will supply a population of twenty thousand. There are now nine and one-half miles of mains, and one more mile will be built.

At Junction City, Kan., there is a plant of two Western Electric arc light dynamos, that have been in operation about eighteen months, and a Westinghouse incandescent dynamo, which has been in operation only a short time but the demand for lights will soon test the capacity of the plant.

The real estate men of Chicago had a banquet at the Grand Pacific hotel one evening recently and were much delighted at three floral pieces representing houses and lots and lighted by small six volt electric lights. Johnson, Holland & Co. made the installation.

It is reported that the water works company of Lawrence, Kan., has purchased the Bowersock's electric light plant and will remove the dynamo to the engine house and run it by steam. Heretofore the dynamo has been run by water power which sometimes failed when the water was low.

In Buffalo, early on the morning of the February 5th, during a snow and rain storm a telephone wire broke and in falling to the street crossed an electric light wire. A horse driven by Robert Taylor stepped on the wire, became entangled in it and received a shock that knocked him down. At the same instant the young driver received a shock through the wet reins. Not realizing the cause, but supposing the horse had stupidly stumbled the driver hit the horse with his wet whip and received another shock which rendered him unconscious. Isaac Morton, a colored railway porter saw the accident and rushed to the assistance of the horse but when he attempted to lift him he too received a shock which proved fatal, his hands were found to be badly burned and his face was bloated. The same day an accident occurred in Memphis, Tenn. In the edge of the evening a half dozen lads began experimenting with one of the electric light wires which had been connected to a discarded light, but which had been wound around the pole within easy reach of the ground. The boys discovered that they could be shocked and were enjoying the sensation when one of their number touched the wire with a piece of hoop iron and received a shock which killed him.

THE ELECTRIC MOTOR.

We British are fond of having a number of servants in attendance when we dine, runs a Paris letter in *London Truth*. Flunkeys with us are supposed to have ears that hear not, and eyes that see not, what their employers say and do. It would be impossible to suppose anything of the sort in Paris. Masters and mistresses dread the criticisms of the servants' hall, and their highest idea of dining-room comfort is to be served by machinery. The dinner-lift came into fashion in the reign of Louis XV. Electricity is now being used to enable persons of wealth at *dîners intimes* to do without the waiter or the *maitre a'hôtel*. A miniature railway is laid down on the dinner-table and continued on the same level into the kitchen through an aperture in the wall and an intermediate pantry. Dishes come in and, after making the round of the table, go out on a sort of small truck moved by electricity. The truck at any moment can be made to stop. It does its work admirably as a dumb-waiter, and any amount of art can be lavished on it to give it a decorative beauty.

A car fitted according to the system devised by Mr. Lineff, was tested at the depot of the West Metropolitan Tramway company at Chiswick, says the London *Electrical Review* of the 27th ult. Mr. Lineff's invention consists in the method of conveying the current to the tram car. The current was generated by means of a stationary engine and dynamo placed in an engine house at the depot, in the yard of which an experimental line nearly a quarter of a mile in length has been laid down. An Immisch series wound dynamo was used, and the current was conveyed along the line by a copper insulated wire conductor, carried in a channel running centrally to and parallel with the rails. At intervals on the conductor small saddle-shaped rubbers were mounted, and from the underside of the tram car a wire was suspended between two vertical arms which entered in and ran in a groove formed in the upper part of the channel. The wire was of sufficient length to touch several of the saddles at the same time, and by this means the current was transmitted from the conductor to an Immisch series wound motor placed under the floor of the car. Motion was transmitted to the wheels of the car through gearing, and the car was started and stopped by switching the current on or off by a very simple apparatus operated by a small handle in front of a dial. On this dial were marked the necessary indications for guiding the driver as to the point at which the handle should be placed to effect any given purpose. The car was completely under the driver's control, and when running at a fair speed, could be stopped within its own length by means of an electrical brake. There is an arrangement whereby the brake is made self-acting. A hinged guard board is placed at each end of the tram car just clear of the road. Directly the board comes in contact with any object on the line the car is stopped and reversed. A number of runs were made with the Lineff car, both loaded with passengers and empty. It has been estimated, we learn, that the adoption of this system by the West Metropolitan Tramway company would effect a saving of about 50 per cent. upon the present cost for horse traction, and it is stated that arrangements are being made for trying it on the line from Hammersmith to Kew.

THE TELEPHONE.

In the London *Electrical Review* of Jan. 27th appears an illustrated description of a Swinton patent direct intercommunication telephonic system. A system original with the Western Electric company of Chicago and precisely similar in all its details was described and illustrated in the WESTERN ELECTRICIAN, Vol. I, No. 1, July 2, 1887. The system had been in use some time in their own factory and in a number of other installations.

At the meeting of the College of Physicians in Philadelphia, recently, Dr. John Girdner of New York exhibited, by invitation of the college, for the first time, his telephonic probe, and explained its mode of application. The instrument is used to locate a bullet or other metal substance that has become lodged in the body. It is operated by the electricity in the patient. It consists of three parts—one, a sort of phone, which is placed over the physician's ears, a steel probe, and a steel bulb. The bulb is placed in the patient's mouth and the probe is inserted in the wound. If the probe strikes a piece of bone it makes no response, but if it strikes the metal which caused the wound it gives distinct clicking sounds.

General C. L. Williams, of the Brown Magneto Telephone company, exhibited the instrument made by his company in Rochester, N. Y., recently. It was stated that the right to use the instrument in Monroe county could be purchased for $10,000 and 40 per cent. of the stock of the local company. Instruments would be furnished at $18 each, with a royalty of $3 after the first year. It is claimed that a company with a capital of $100,000 and having an exchange of 900 members, could furnish the telephones at $25 or $30 each and make a handsome profit from the investment.

THE TELEGRAPH.

Mr. Scrymsek, president of the Mexican Telegraph company, reports steady improvement in telegraph business in Mexico, and great accuracy in the service over the lines of his company; stating that only ten errors per month occurred during September and October last, in the transmission of 170,000 to 180,000 words per month.

The London Exchange Telegraph company is now using E. P. S. accumulators to work the stock exchange "tapes" from their office in Cornhill. There are employed 210 accumulators, arranged in three series of seventy each, in place of 2,000 primary batteries, which were previously installed for the same purpose.

Miscellaneous Notes.

At the meeting of the Town of Lake, Ill., Board of Trustees, on the 7th inst., the Equitable Transportation company submitted an ordinance asking permission to construct and maintain an elevated railroad from Thirty-ninth street to Eighty-seventh street, on State street, besides being allowed to run in other streets. The matter was referring to the committee of the whole.

Edgar C. Dodge, a young electrician in the employ of Armour & Co., Chicago, has invented an appliance for waking lazy folks early in the morning. By a few simple changes in the mechanism of an ordinary nutmeg clock he arranges it so that when it is placed between two brass keys on the top of a wooden box containing a single cell battery, it starts instead of the ordinary clock alarm, an alarm which the most inveterate laggard could not fail to heed. Attached to the box and the battery is a buzzer and a gong bell. When the appointed hour has been reached the mechanism closes the electric circuit between the brass pegs on the top of the battery box, and keeps up the racket until the sleeper arises and lifts the clock off the box. In no other way can he stop the noise. The changes in the clock do not impair its usefulness in any way, and, indeed, are so slight that no one would notice them. Mr. Dodge has tried his clock with great success on some of his early rising acquaintances.

J. H. Winville has invented an electrical typewriter, now controlled by the International Printing Telegraph company, of Philadelphia. The machine is a combination of a type-writer and an ordinary telegraphic instrument, by means of which the operator, pressing the keys on the board of a type-writer at one end of a telegraph wire, may make a type-writer copy at the other end of the wire. The transmitting machine also makes a copy of the message. The same machine can be made a transmitter. At a recent exhibition both transmitting and receiving instruments

were in the company's office in Philadelphia, but the message was said to go out to Pottsville and thence back to Philadelphia by a loop in the telegraph wire. Several pages of matter were printed.

John M. Ives, connected with the patent medicine concern of H. H. Warner & Co., of Rochester, N. Y., but for three years a resident of Australia is now in America for the purpose of interesting American merchants and manufacturers in the centennial exhibition to be held at Melbourne next August and continuing six months. The exposition buildings will cover twenty-four acres of ground, and 500,000 square feet of this space is to be set apart for the display of American products. All goods shipped from this country for exhibition will be admitted free of duty, but as high protection is the policy of the colony no goods can be sold there after being entered free. The colonies are preparing to make a great display. Americans in Chicago or vicinity desiring space for the exhibition of their goods can apply to E. C. Stebbins, 90 Franklin street.

Personal Paragraphs.

The wedding of William Taylor and Miss Charlotte W. Dee took place Thursday, February 9th, at St. Luke's church, South Evanston, Ill. Mr. Taylor is well known as the assistant manager of the Electrical Supply company, of Chicago, and has many friends who will unite in wishing him much happiness.

Chas. A. Matcham, manager of the Pennsylvania Telephone company at Allentown, Pa., and formerly connected with the Chicago Telephone company, has just returned from a two months' vacation in the old country.

At a recent meeting of the directors of the Jarvis Engineering company in Boston, Mass, a motion was unanimously passed insisting upon a six months' vacation on the part of the genial treasurer and general manager, A. F. Upton. While it is to be regretted that such action was necessitated by the state of Mr. Upton's health, the unanimity of insistence that he should take a rest, is very complimentary to that gentleman's abilities. Mr. Upton has been a hard worker, and notwithstanding that he was a great sufferer from rheumatism, kept at his desk until the directors of the company realized the possibility of losing a most capable and valuable officer unless force was applied and he was driven to seek a rest. Mr. Upton and family are now recreating at Aiken, S. C.

Business Mention.

Samms & Appleton have established an electrical repair shop at 116 Dearborn street, room D, Chicago.

The Electrical Supply company, of Chicago, have issued a neat, handsome and exhaustive catalogue relating particularly to electric light construction material. It covers the wide range of everything necessary to erect a line complete, including not only the material proper, but the best appliances for erecting the line, and in addition, devotes no small space to fixtures for electric light plants.

The Chicago Electrical Development company, 225 Dearborn street, Chicago, is now fully organized, with the following officers: Geo. E. Marshall, president; J. M. Lyon, secretary; F. S. Terry, treasurer. The capital stock is $100,000. This company deals in electrical patents and securities and promotes electrical inventions of all kinds. It has every department complete for obtaining patents, and placing patented articles on the market. Inventors will undoubtedly find it to their advantage to correspond with them.

The Jarvis Engineering company of 81 Lake street, Chicago, have recently set two boilers for J. C. Gould, Sangamon and Jackson streets, Chicago, that are giving much satisfaction, making absolutely no smoke.

S. A. Barton, general manager of the Thomson-Houston Electric company, who has lately returned from a trip east, states that the new addition to the company's factory at Lynn, Massachusetts, is now completed and they are moving in. The Thomson-Houston factory now covers nearly three and one-half acres of floor space and the incandescent department will shortly be able to turn out 3,500 incandescent lamps per day. The business of the Thomson-Houston company is simply enormous, both east and west, and the foreign business is large and constantly growing.

The Partz Electric Battery company of 1723 Chestnut street, Philadelphia, have placed on the market a two-cell battery for use in connection with a C. & C. motor, designed to run sewing machines. The expense for maintenance is said to be normal. Motor, battery and speed regulator in a case complete will be sold for $25.

The Reliance Oil & Grease company of Cleveland, Ohio, have just placed upon the market a machine oil especially adapted to dynamos and also a brand of oil called valv-oleine for valves and cylinders. Samples of their different brands, neatly packed in case, will be mailed free upon application.

The Link Belt Machinery company of Chicago alive to the demands of Electric Lighting are now prepared to furnish rope transmission using manilla, cotton or raw hide rope as occasion demands. They have recently secured several large contracts for rope transmissions.

The Heffron fire-proof European hotel in Chicago will be lighted by a plant of 300 16 candle power lights of the Excelsior Electric Light company's system. A Russell engine of 110 horse power will run the plant. In case the open board of trade building is lighted electrically, it will be done by increasing the plant mentioned to 2,000 lights.

H. A. Glasier, manager of the western department of the Jarvis Engineering company, reports business as largely increasing. Among the contracts recently made are one for an electrical railroad; two large water works stations; four electric light stations; one woolen mill; two paper mills; one office building; one hotel; one agricultural works; one vinegar works and one flouring mill, aggregating thirty-one furnaces.

The National Rocking Grates and Sheffield Grates sold by the Jarvis Engineering company of 81 Lake street, Chicago, are having a large sale in the West and giving the best of satisfaction; among recent sales are two sets 6'x6' National rocking grates, second order; two sets 4'x4' rocking grates; four sets Sheffield grates 6'x9'; one set 5½'x11'; besides several smaller sets.

The Electrical Supply company of Chicago find their sales of P & B wire increasing rapidly. This wire has deservedly become popular and seems to give general satisfaction. The insulation resistance is good and is not affected by moisture, cold, heat, acids or alkalier. Another specialty of the Electrical Supply company is a new box bell which besides being good, substantial and of moderate price, is ornamental as well. This bell has just been put upon the market and a large sale is undoubtedly assured for it.

Electrical Patents.

Issued Feb. 7, 1888.

377,374. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

This invention relates to an improvement in acoustic telegraphs and consists of a combination with a line wire and battery, of a circuit preserving and reversing key, a vibrating circuit-breaker and a short-circuiting key at the transmitting station, a polarized relay, and a reed or vibrating receiver and sounder at the other station, whereby one set of signals can be operated upon the line by the vibrations of the current and the key to short-circuit the same, and the other set of signals can be operated by the reversal of the current.

377,383. Electro-Magnetic Grain Weighing Scale. Wm. A. Holley and Ulrik Malin, Holland, Mich.

The first of the eight claims is given: "The combination of a scale, a double hopper carried thereby, having a discharge valves, the detents, means connecting the same, and an electric circuit constructed and arranged to be controlled by the scale beam, whereby the discharge valves are permitted to open by the weight of the grain."

377,397. Electric Railway. Washington I. Ludlow, Cleveland, Ohio.

This invention relates to the construction of a T-rail, substantially in two equal vertical sections with an electrical conduit laid in a space between the two sections.

377,413. Electrical Apparatus for Effecting Mechanical Movements. Roswell T. Smith, Nashua, N. H.

377,441. Transfer Switch and Circuit for Telephone Exchanges. Charles E. Scribner, Chicago, Ill.

The second of the two claims follows: "The combination, in a telephone exchange, of two or more switch-boards to which different groups of telephone lines are connected, with transfer or trunk lines connecting said boards together, the terminals of said trunk or transfer lines on the different boards being spring jack switches, two of such terminals being provided for each transfer wire on each intermediate board and a ground circuit connection for each transfer wire, whereby a line connected at one board will be closed at the other board either to line or to the ground connection of the transfer wire to which the line is connected."

377,475. Telephone Transmitter. John F. Bahr, Jersey City, N. J.

377,487. Process of Electrolyzing Copper. Edward S. Hayden, Waterbury, Conn.

The third claim sets forth the object of the invention: "The process of separating from copper and like metals foreign matter which may be incorporated with them, consisting in arranging in an electrolytic bath, an anode plate and a cathode plate, interposing between the latter one or more of the plates to be treated, leaving the same electrically unconnected, save through the solution; in gently circulating the solution from the upper to the lower portion of the bath, and in subjecting the plates to the action of a current of electricity."

377,488. System of Electrical Distribution. John W. Howell, New Brunswick, N. J.

The invention relates to the Edison system of electrical distribution and its object is to dispense with the number of electromotive force indicators, to simplify the apparatus at the central station and at the same time to provide exact means for indication of the electromotive force at the end of each feeder.

377,505. Electric Gas-Lighting Burner. Le Roy S. White, Waterbury, Conn.

377,518. Magnetic Separator. Thos. A. Edison Llewellyn Park, N. J.

The object of this invention is to cause the separation of magnetic from non-magnetic particles by permitting them to fall together past the poles of a magnet which alters the trajectory of the magnetic particles so that they fall separately from the non-magnetic particles. A closed air chamber is used in combination so that the falling particles will not be affected by air currents.

377,538. Electric Circuit Closer. William F. Stocker, Eureka, Kan.

377,539. Electric Bell. William F. Stocker, Eureka, Kan.

377,553. Electric Gas Lighter. Julius Finck, San Francisco, Cal.

377,591. Automatic Grain Weighing Apparatus. Edwin R. Whitney, St. Johnsbury, Vt.

The first claim is given: "In an automatic grain weighing machine, the combination, with a suitable framing, of a hopper suspended therein and having two compartments adapted to be filled alternately through separate mouths and having a common discharge opening, a graduated scale-beam fixed to said hopper and having an adjustable weight thereon, a swinging door adapted to control the discharge of each compartment of the hopper through the common opening, and a pendulous weight in connection with the door and hanging in the central line of gravitation, the whole being combined and arranged so that one compartment will be filled with a regulated quantity of grain while the other is being emptied."

377,612. Telephone Transmitter. Hammond V. Hayes, Cambridge, Mass.

377,615. Electric Arc Lamp. Edward E. Higgins and John James, St. Johnsbury, Vt.

The invention has reference to the mechanism used in electric arc lighting to feed the upper carbon.

377,622. Electric Motor Car. Walter H. Knight, New York, N. Y.

The invention relates to the use of non-resonant material around the motor and gearing of a motor car to reduce the noise.

377,626. Electro-Mechanical Signal Apparatus. William W. Le Grande, Louisville, Ky.

This invention relates to improvements in apparatus for operating railway and similar signals.

377,634. Railway Signal. Thomas S. Nicholson, Mount Washington, Ohio.

377,642. Secondary Battery. John S. Sellon, Hatton Gardens, County of Middlesex, England.

The third claim follows: "In a secondary battery, a series of perforated positive plates and a series of perforated negative plates interleaved therewith, a series of plugs of insulating material extending through and projecting from both surfaces of one series of plates, active material filling the other perforations of said plates, plates of insulating material upon opposite sides of the series of battery-plates, and bands of insulating material uniting the whole."

377,683. Armature for Dynamo Electric Machines. Richard H. Mather, Windsor, Conn.

The second and third claims are given: "1. A cylindrical armature-drum traversed longitudinally by conductors which pass circumferentially from side to side of said drum at one end of the same and diametrically across the other end of the same, substantially as and for the purpose specified.

"2. A hollow cylindrical non-magnetic and insulating armature-drum open at one end or closed by a removable cover and containing a stationary core mounted upon the same shaft, substantially in the manner and for the purpose specified."

377,684. Electro-Mechanical Movement. Richard H. Mather, Windsor, Conn.

The invention consists of an electric motor and relay connected in a peculiar manner and producing motion in one direction or another according to the strength of the electric current by which the movement is actuated.

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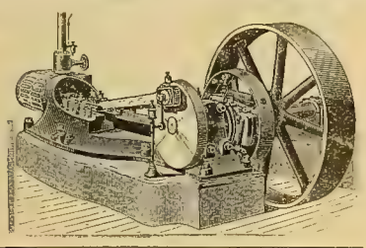

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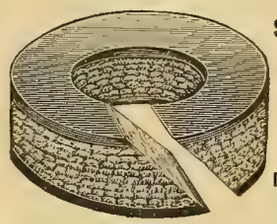

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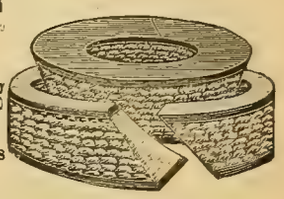

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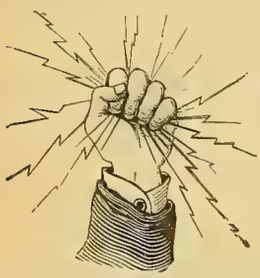

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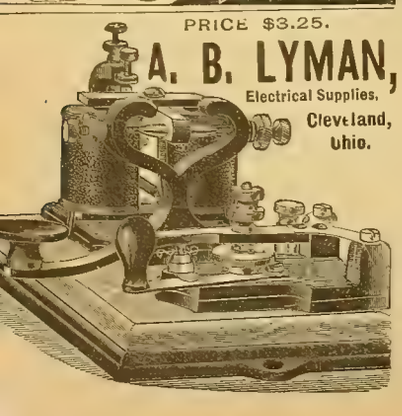

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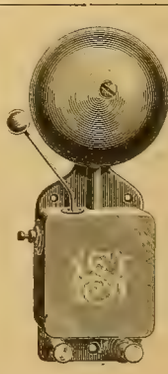

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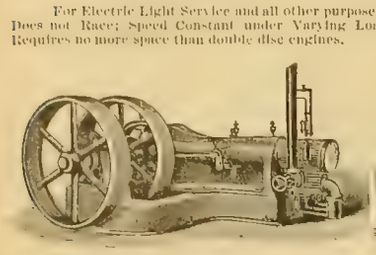

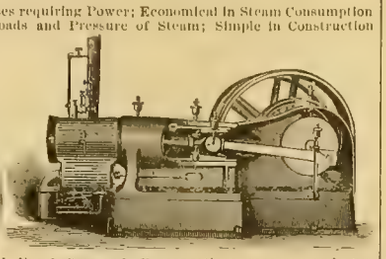

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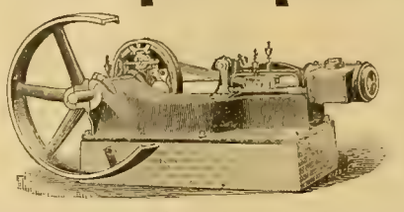

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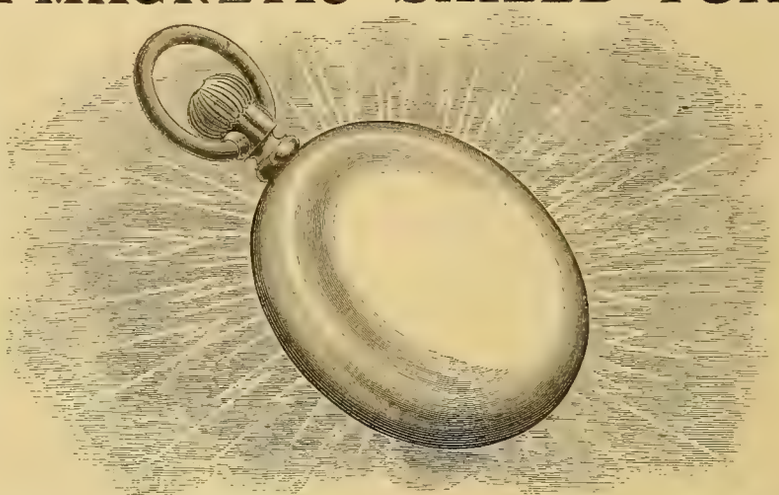

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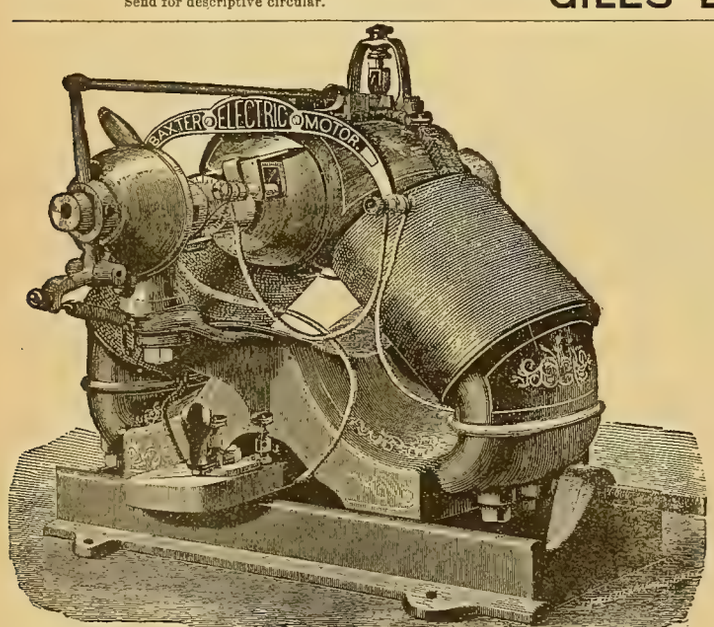

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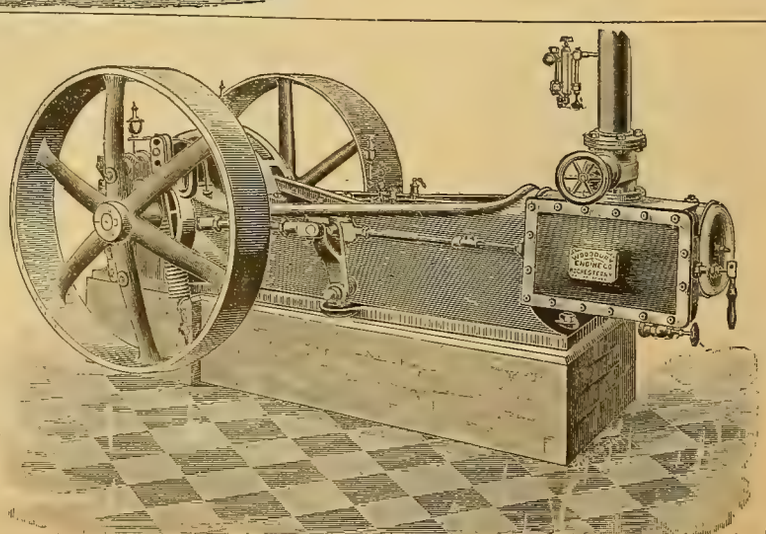

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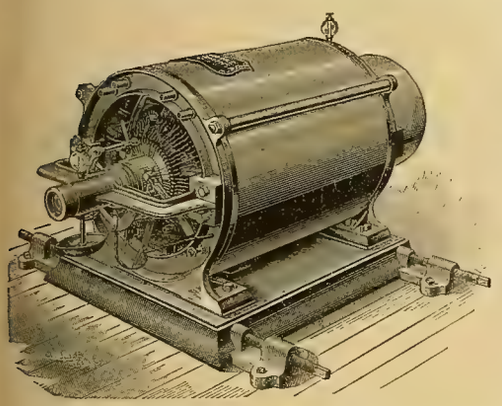

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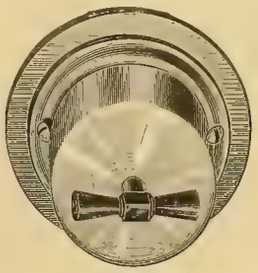

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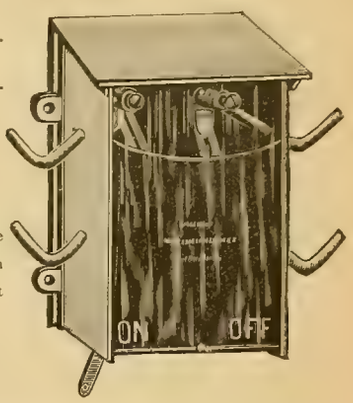

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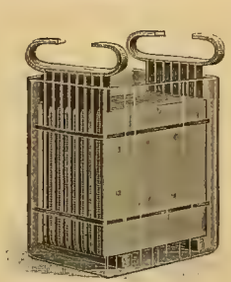

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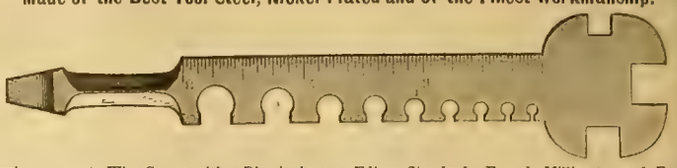

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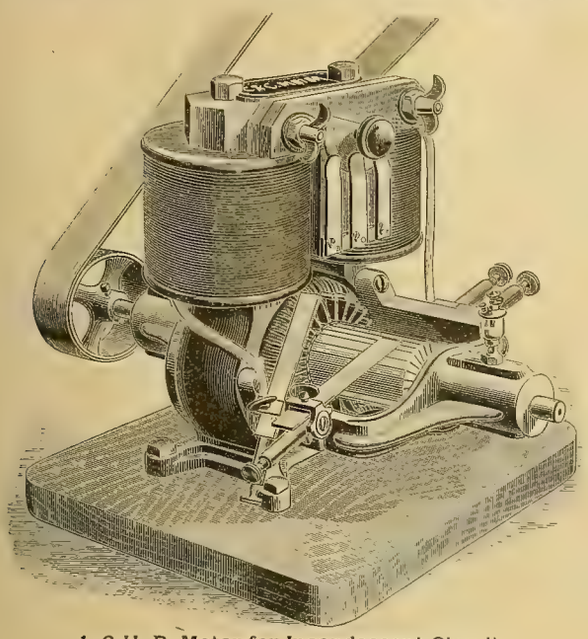

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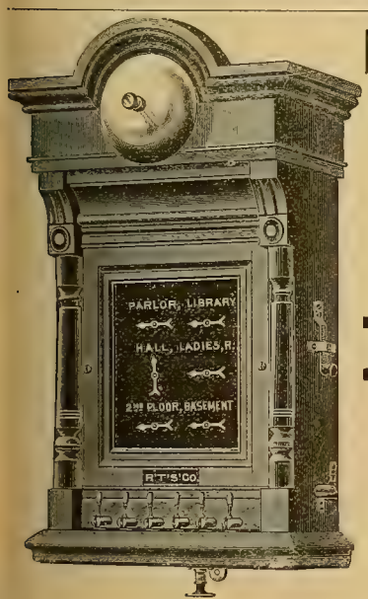

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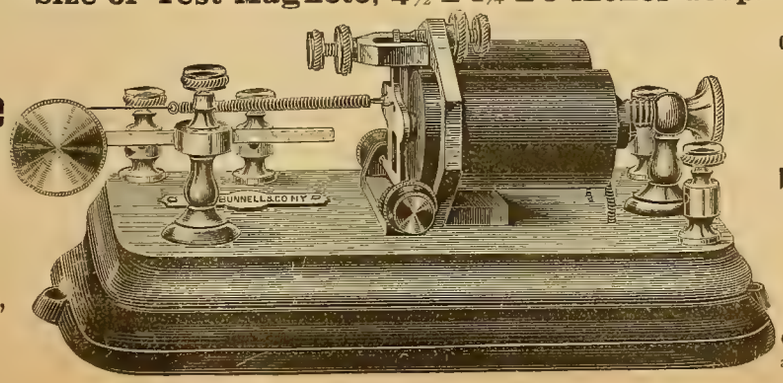

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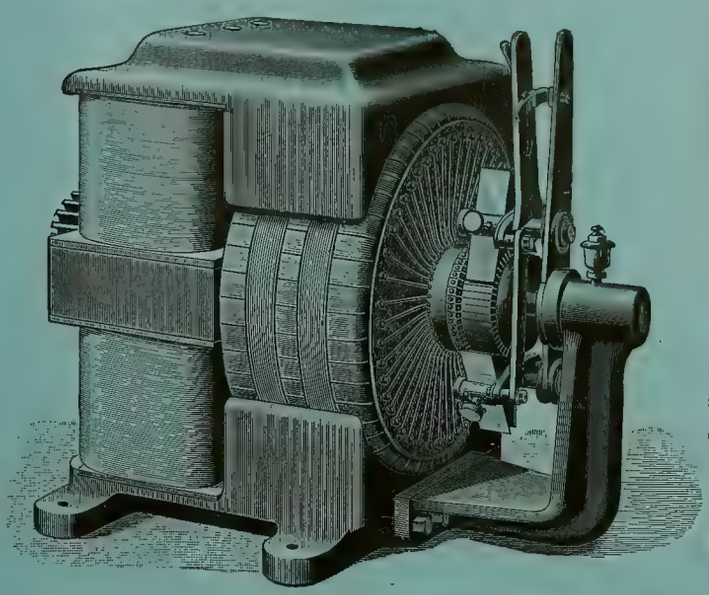

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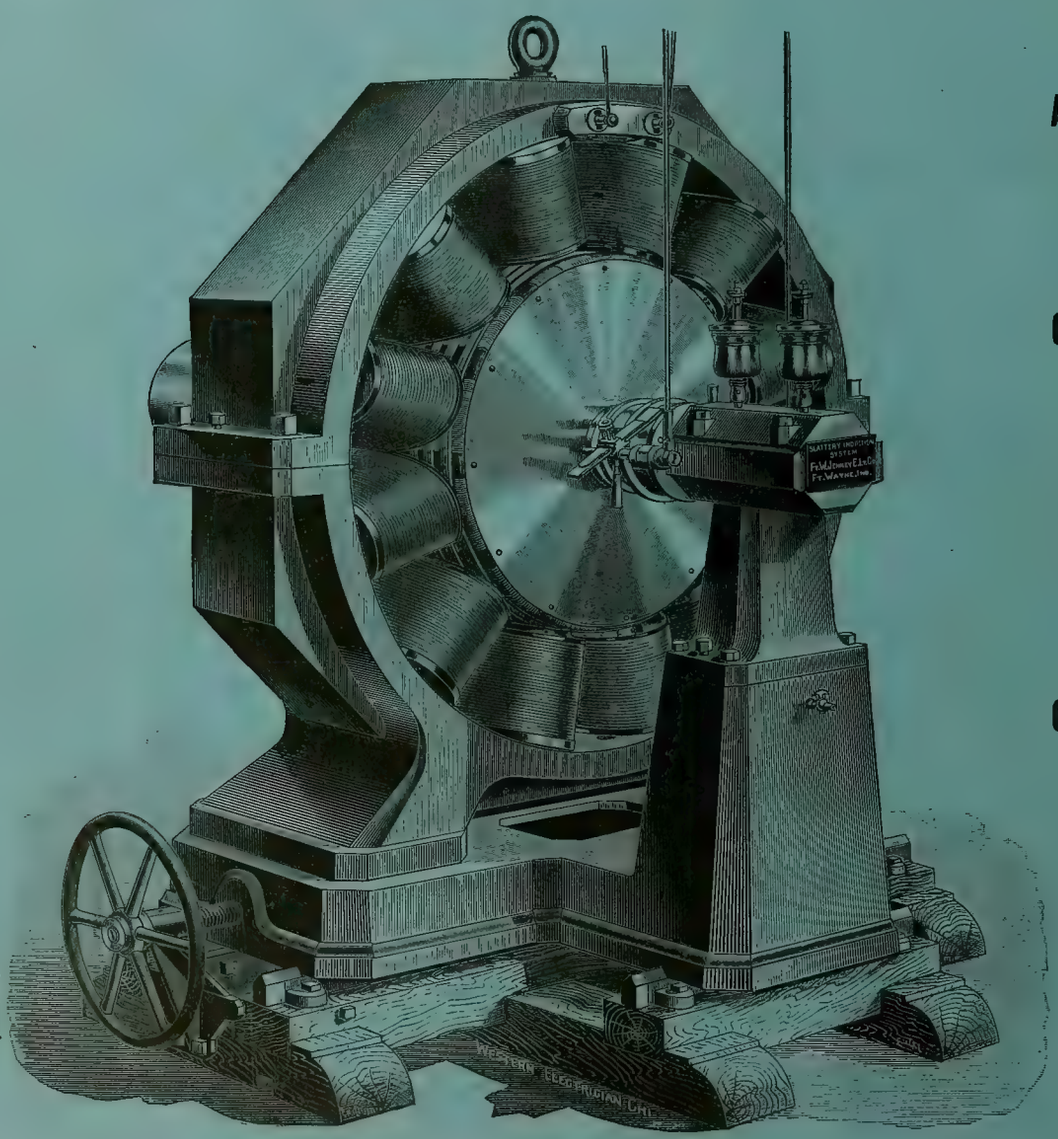

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Vol. II. CHICAGO, FEBRUARY 25, 1888. No. 8.

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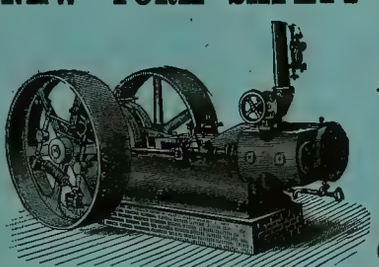
CLARK B. HOTCHKISS, Gen'l Mgr., - 16 Dey St., NEW YORK.

NEW YORK SAFETY STEAM POWER CO.,

Builders of High Grade Self-Contained



Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.

WESTERN OFFICE AND WAREROOMS:

64 & 66 S. Canal St., Chicago, Ill.

WM. A. HAMMETT, Manager.

AMERICAN Leather Link Belt Co.

A NEW BELT

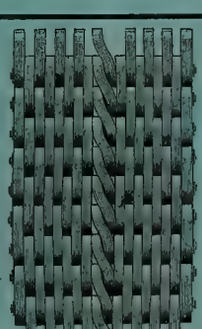
Especially adapted for use with Dynamos.

Write for particulars and prices to

CHAS. A. SCHIEREN & CO.

47 Ferry Street, - NEW YORK.

BRANCHES { PHILADELPHIA, 416 Arch Street. BOSTON, 86 Federal Street.



AMERICAN PAT. JOINT.

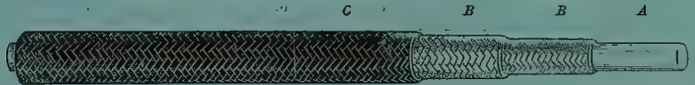
ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A



CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

WAREROOMS: { 19 and 21 Cliff St., New York. 64 Washington St. Chicago, Ills.

FACTORIES: ANSONIA, CONN.

DANIEL W. MARMON, President.
ADDISON H. NORDYKE, Vice-President.

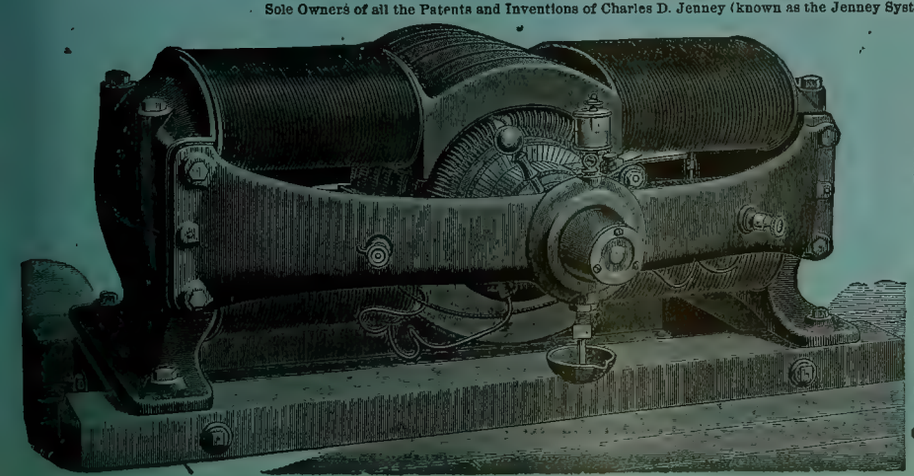
CHARLES D. JENNEY, Electrician.

BRAINARD ROBISON, Secretary.
AMOS K. HOLLOWELL, Treasurer.

JENNEY ELECTRIC COMPANY.

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to Electrical Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St

INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

EASTERN OFFICE:
178 DEVONSHIRE STREET, BOSTON.

WESTERN OFFICE:
PULLMAN BUILDING, CHICAGO, ILL.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.

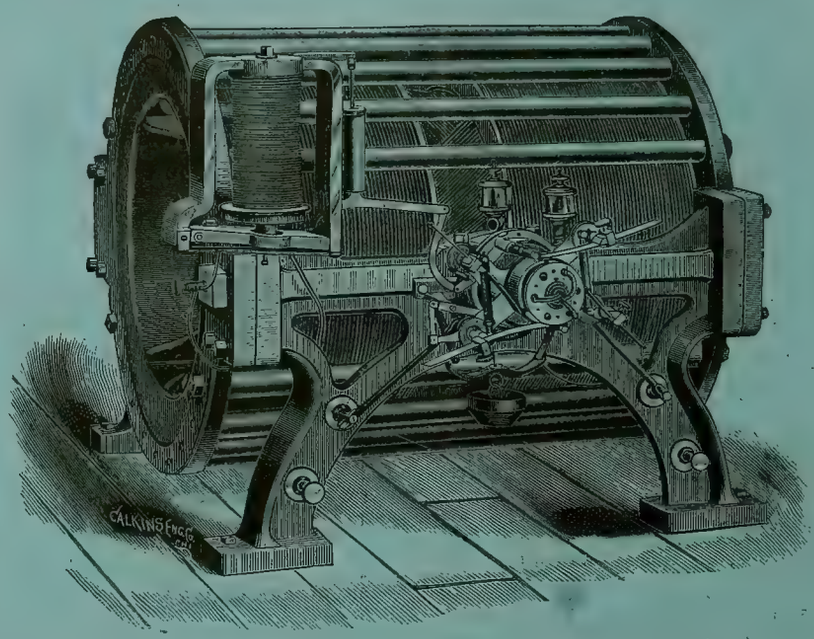
SERIES LAMPS

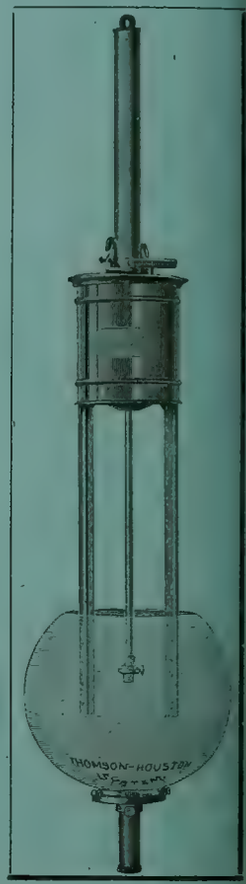
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.





This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

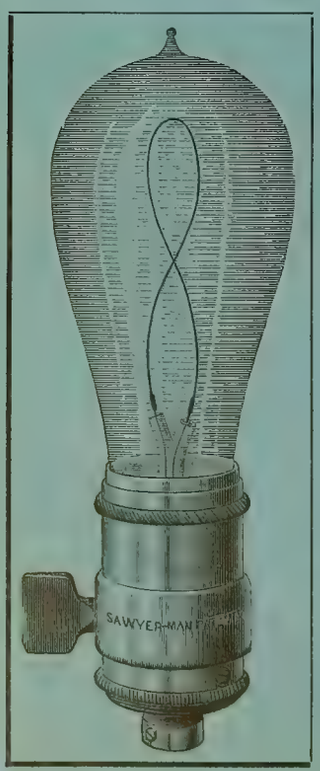
ALSO MANUFACTURERS OF

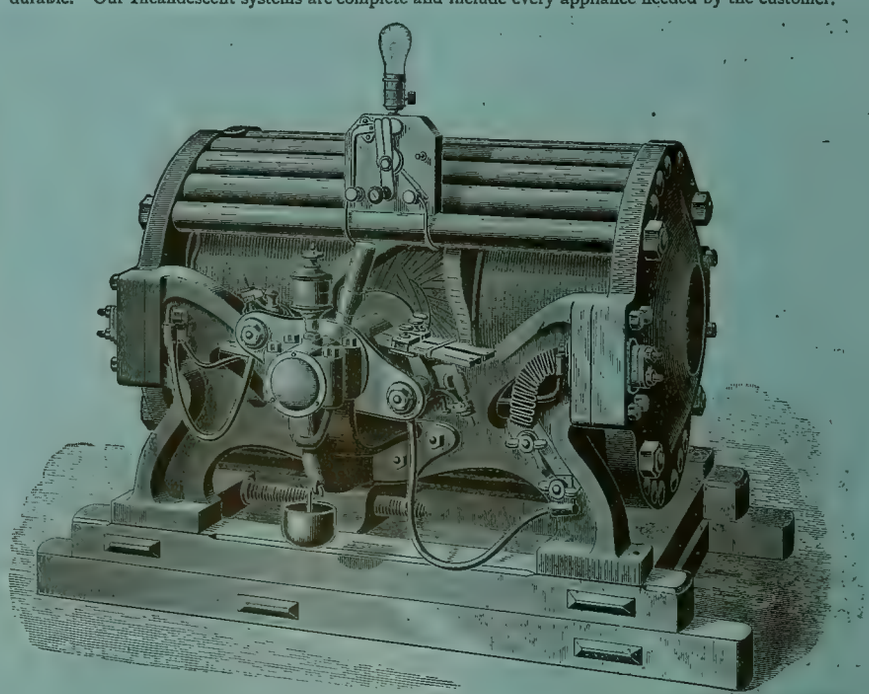
INCANDESCENT DYNAMOS

FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS,

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc, and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-CANDLE POWER LAMPS GUARANTEED PER COMMERCIAL HORSE POWER.

MINNEAPOLIS, NOV. 17, 1887.

EDISON UNITED MANUFACTURING CO.,
65 Fifth Avenue, N. Y.

GENTLEMEN:

The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,

LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, GENERAL AGENTS EDISON UNITED MFG. CO., 185 DEARBORN ST., CHICAGO.

U. S. OLD LAMP

IN GRAND OPERA HOUSE, MINNEAPOLIS.

WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful Indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of J. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=11$\frac{50}{100}$ per H. P.
EDISON 348 LAMPS REQUIRING 54 H. P.=6$\frac{44}{100}$ per H. P.

COMMENTS ARE UNNECESSARY.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, MANAGER. 216 LA SALLE STREET, CHICAGO.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

Electric Light Carbons

AND

BATTERY MATERIAL.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

LAVA INSULATORS.

ABSOLUTELY

Fire, Water and Acid Proof.

MADE FROM MODEL IN ANY SHAPE.

Have stood severest tests, can furnish highest testimonials from largest manufacturers of Electrical machinery in the world. Samples and estimates sent on application. Cheaper than any reliable insulation.

D. M. STEWARD M'F'G CO., Chattanooga, Tenn.

January 1st, 1888, we removed our entire plant from Cincinnati to Chattanooga, where we have greatly increased facilities in all departments.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

707 and 709 MARKET STREET, - ST. LOUIS.

BRANCH, 521 DELAWARE ST., KANSAS CITY.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

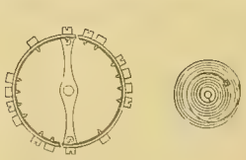
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**

These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

For Sale by all First-class Jewelers.

The Jarvis Engineering Co. Boston, Mass.

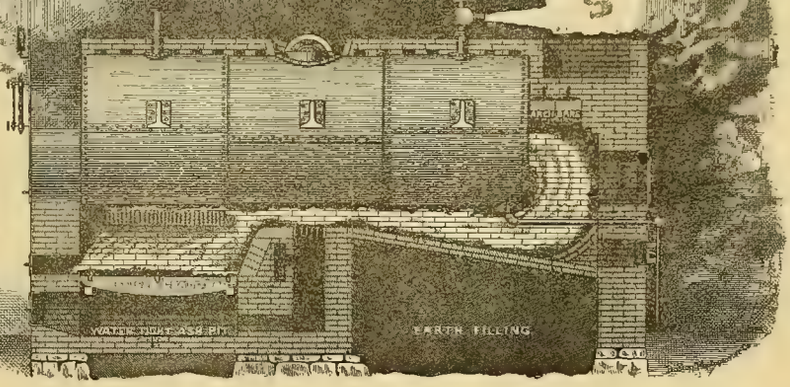
Complete Steam Plants

for Manufacturing Establishments.

also make a Specialty of

Electric Light and Power Stations.

Economy of fuel
with increased capacity
of Steam Power.



THE GREATEST OBJECT TO BE OBTAINED IN PRODUCING STEAM POWER

IS TO USE FUEL WHICH WILL GIVE

The Greatest Amount of Steam at the Least Possible Expense.

THIS THE JARVIS BOILER SETTING AIMS TO DO.

IT HAS NO EQUAL. OVER 3,600 IN USE. COMPRISING OVER 300,000 H. P. BURNS SCREENINGS, SLACK, WET SAWDUST, WET HOPS AND ALL KINDS OF REFUSE FUEL WITH LARGE ECONOMY.

The following list represents the electric light stations and steam plants which have been equipped by the Jarvis Engineering Company (either in whole or in part), in the different cities and towns, up to the present time.

Thomson-Houston Co. System,	65 Stations.	Weston Electric Light System,	8 Stations.
Edison Electric Light System,	46 "	American System,	7 "
Brush-Swan Electric Light Co. System,	14 "	Jenney Electric Light Co. System,	6 "

The following concerns have used the Jarvis Patent Boiler Setting in their mills. Those giving the second or more orders are marked with a *; and we wish to call especial attention to this fact, for if customers were not fully satisfied we should never get duplicate orders. This result tells more than volumes of certificates.

Of Cotton Mills,	*41	Of Phosphate Works,	*6
Of Woollen Mills	*42	Of Iron and Steel Works,	*5
Of Paper Mills,	*29	Of Flour and Grain Mills.	*6
Of Boot and Shoe Manufactories,	*14	Of Chemicals,	*8
Of Machinery,	* 7	Of Tobacco,	*4
Of Water Works,	12 Stations.	Of Salt Works,	*5
Of Engine and Machine Works,	*10	Of Breweries,	*8
Of Soap Works,	* 7	Of Miscellaneous,	*32

WE ARE PREPARED TO FURNISH COMPLETE OUTFITS OF MOTIVE POWER FOR

ELECTRIC LIGHT AND POWER STATIONS.

Including ENGINES, BOILERS, IRON STACKS, BOILER FURNACES, STEAM PUMPS, HEATERS, INJECTORS, Etc.

SEND FOR NEW 1888 CIRCULARS. CORRESPONDENCE SOLICITED.

61 Oliver Street, BOSTON, MASS. — A. P. UPTON, Treasurer and General Manager.

81 Lake Street, CHICAGO, ILL. — H. A. GLASIER, Manager.

109 Liberty Street, NEW YORK CITY. — J. N. PRATT, Manager.

Callender Insulating and Waterproofing Co.,

TRINIDAD LINE WIRE.

The attention of Electric Light, Telephone and District Messenger Companies is especially called to our new

——TRINIDAD LINE WIRE.——

The universal condemnation of the so-called Underwriter's Wire, and the demand for something better, has induced us to offer our new TRINIDAD LINE WIRE as a substitute for its use, and at a very little higher price. This wire is served with two coatings of our Bitumenized Tape and braided over all. A serving of Trinidad Compound is put on between each tape and braid. The outside finish is neat, clean and strong. It will not liquify or become sticky with heat, nor brittle with cold. The covering is tough and tenacious, will stand rough usage and a rubbing contact without abrasion. We claim that our Trinidad Line Wire is the cheapest, well insulated, and most serviceable wire offered for all Pole work, especially for high tension currents. This wire has received the highest indorsements, and is recommended as the best line wire by the Thomson–Houston Company, of Boston.

Underground Incandescent Cables.

ILLUMINATING COMPANIES proposing an extension of their Incandescent Plants are invited to correspond with the undersigned before commencing construction. With ou reeent improvements and reductions in price the cost of placing large Incandescent Cables underground in a solid and substantial manner is brought within actual business limits.

THE CALLENDER COMPANY have, during the last two years, laid many miles of large Cables underground, all of which are in actual work. Almost every inch of the Underground Incandescent Work, both in this Country and in Europe, has been laid on the Callender plan. The difference in cost between an overhead and underground system for Incandescent work is now no greater than is warranted by the better service insured by an underground system, The Callender Company's Underground Incandescent Cables and System have been in actual operation for some two years in twelve cities, and are indorsed by all the parent light companies.

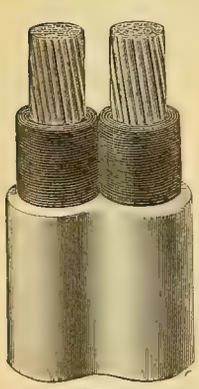
Manufacturers also of insulated wire for Electric Lighting for house purposes, and in all places where good insulation is required. Plans and Detailed Estimates on Application.

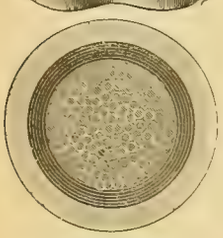
THE CALLENDER INSULATING AND WATERPROOFING CO.

HEAD OFFICES: 45 Broadway, New York. 101 Leadenhall St., London. FACTORIES: East Newark, N. J. Erith, England.

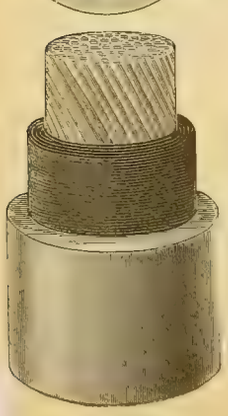
BRANCH OFFICES: 154 La Salle St., Chicago. 12 Broad Street, Boston. 195 Gravier Street, New Orleans.
Southwestern Electric Supply Co., Kansas City. Quai de Willebroeck, 21, Brussels, Belgium.

TWO CONDUCTOR ELECT. LIGHT CABLE. FULL SIZE. No. 1, B. & S. G.





ELECTRIC LIGHT CABLE, FULL SIZE. 500,000 CIRCULAR MILS.



W. A. C. FIRE AND WATERPROOF WIRE,
Full Size, No. 0, B. & S. G.

STANDARD WEATHERPROOF WIRE,
Full Size, No. 1, B. & S. G.

WEATHER PROOF LINE WIRE,

Insulated Wires and Cables for Telephone, Telegraph,

Electric Light

——AND——

POWER.

GEO. WESTINGHOUSE, Jr., President.
C. H. JACKSON, Vice-Pres. and Gen. Mangr
JNO. H. DALZELL, Treasurer.
J. W. MARSH, Secretary.

STANDARD UNDERGROUND CABLE CO.,

MANUFACTURERS OF THE WARING CABLES.

Main Offices: 708 Penn Avenue, Pittsburgh, Pa.

New York: 18 Cortlandt Street, G. L. WILEY, Manager.

Chicago: 139 E. Madison Street, F. E. DEGENHARDT, Manager.

DESCRIPTIVE CIRCULARS AND INFORMATION MAILED TO ANY ADDRESS ON DEMAND.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

Arc and Incandescence

Electric Lighting Apparatus

CHICAGO OFFICE:

130 Washington Street,

CHICAGO, ILLINOIS.

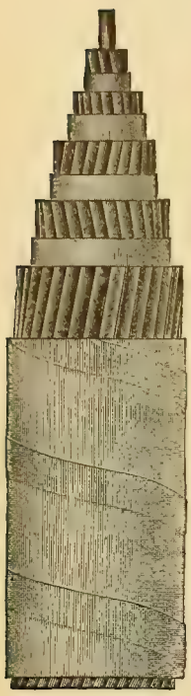
CHAS. A. CHEEVER,
President.

WILLARD L. CANDEE,
Treasurer.

THE OKONITE CO.

13 PARK ROW, N. Y.

TRADE MARK.



INSULATED WIRES AND CABLES

FOR TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT USES.

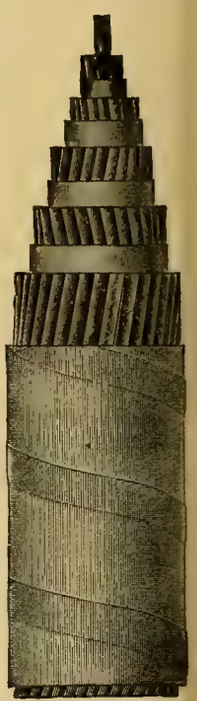
☞ Those who have the **OKONITE** wires and cables in use are unanimous in their declarations that it is the **BEST INSULATED** medium in the market, and as for **durability** and **toughness** of compound it is unsurpassed for

AERIAL, SUBMARINE AND UNDERGROUND USE.

After several years' use OKONITE TAPE stands without a competitor. It has proved all we claimed for it, being thoroughly water-proof, and a perfect insulating medium.

AERIAL, SUBMARINE AND UNDERGROUND USE.

It is not affected by exposure to weather, and does not deteriorate when submitted to extreme changes in temperature, and is not affected by commercial acids or alkalies.



No. 91 CONDUCTOR.
No. 16, B. W. G., $\frac{6}{32}$ Insulation.
OKONITE CABLE.

Electric Light Wires Solid, Stranded or Flexible, with plain or braided Insulation, Flexible lamp cord, for incandescent lighting, silk or cotton braided

NEW CIRCULARS NOW READY. HIGHEST TESTIMONIALS.

BRANCHES:

CHICAGO, MINNEAPOLIS, OMAHA, PHILADELPHIA, BOSTON. KANSAS CITY.
38 & 40 LaSalle St. Minn. Electric Co. Midland Electric Co. Novelty Electric Co.

WEST COAST TELEPHONE CO., - - SOUTH AMERICA.

No. 91 CONDUCTOR.
No. 16, B. W. G., $\frac{6}{32}$ Insulation.
OKONITE CABLE.

STANDARD ELECTRICAL WORKS,

MANUFACTURERS OF

HOTEL AND HOUSE ANNUNCIATORS. **Telegraph and Telephone Apparatus,** BURGLAR ALARMS.

SOLE MANUFACTURERS OF THE

THE SYSTEM OF GUEST CALL, FIRE ALARM & ANNUNCIATORS COMBINED.

CALL BELLS, "POST'S" MAGNETO BELLS, PINS AND BRACKETS, BATTERIES, ETC. ETC.

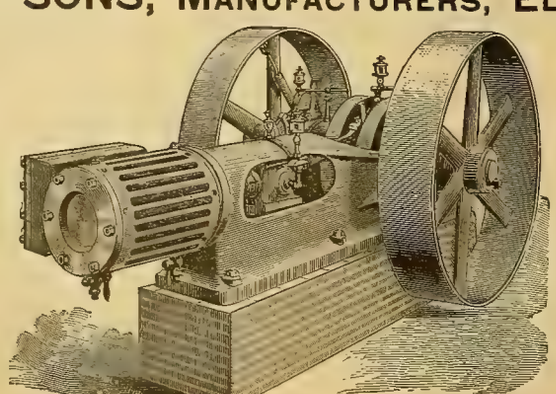
In Stock: Full Line of Iron, Steel and Hard-Drawn Copper Wire, Delivered at Lowest Prices.

☞ ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES. ☜ CINCINNATI, OHIO, U. S. A.

PAYNE AUTOMATIC ENGINE.

B. W. PAYNE & SONS, MANUFACTURERS, ELMIRA, NEW YORK.

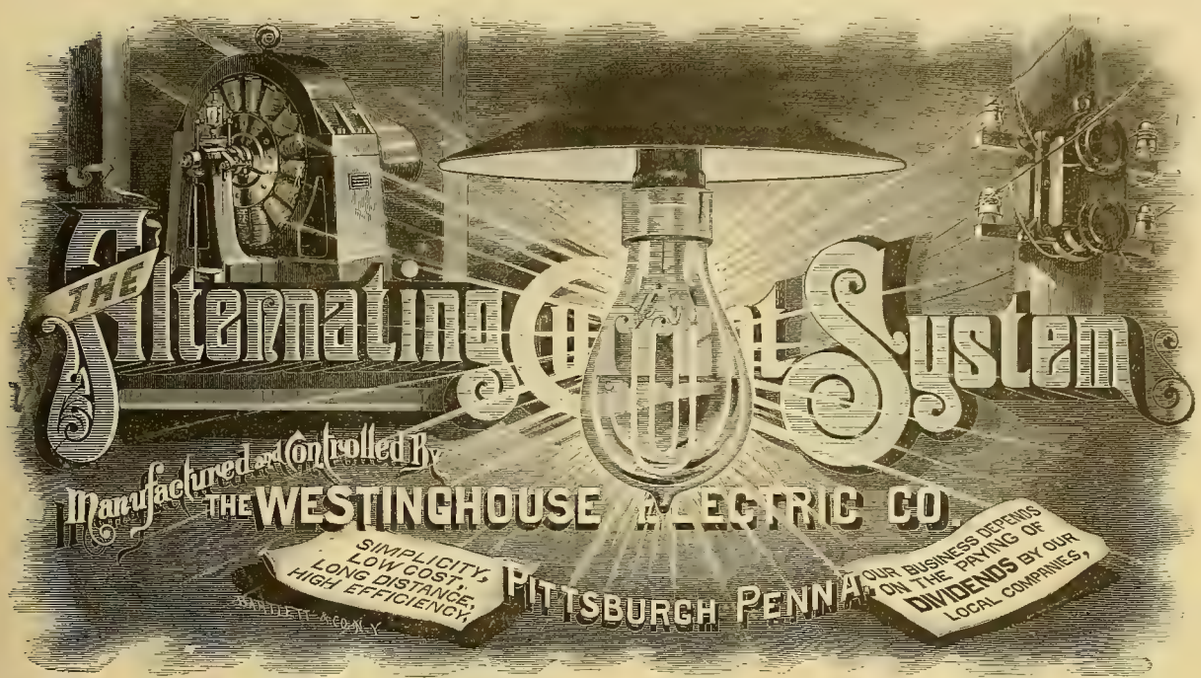
BUILDERS OF
Single Valve and Corliss Valve
ENGINES.
SELF CONTAINED AND SINGLE CRANK
ENGINES
Specially Adapted for Electric Lighting.

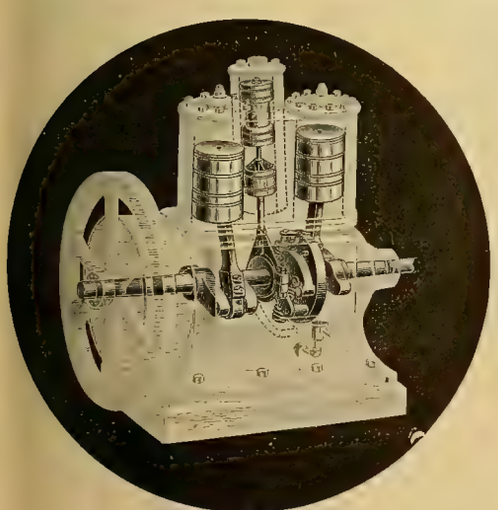


WESTERN DEPARTMENT:
No. 10 S. Canal St.
CHICAGO.

H. S. WALKER, MANAGER.

TELEPHONE 4024.





DIVIDED POWER

SHAFTING { Costs to Purchase / Costs to Maintain / Costs to Lubricate / Costs to Drive } VERSUS THE **Westinghouse ENGINE.**

Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

SELLING DEPARTMENT
CONTROLLED BY

Westinghouse, Church, Kerr & Co.
17 Cortlandt Street.....New York.
97 Fifth Avenue.....Pittsburgh.
156 and 158 Lake Street.....Chicago.

Fairbanks & Co.
302 and 304 Washington Ave.....St. Louis.
1312 Union Avenue.....Kansas City.
1330 Seventeenth Street.....Denver, Col.

Utah and Montana Machinery Co.
259 South Main Street.....Salt Lake.
East Granite Street.....Butte, Mont.

Parke & Lacy.
21 and 23 Fremont St.....San Francisco.
33 and 35 N. Front St.....Portland, Or.

The D. A. Tompkins Co.
36 S. College St..Charlotte, N. C.
46 S. Pryor St.....Atlanta, Georgia.

ELECTRIC LIGHT CARBONS.

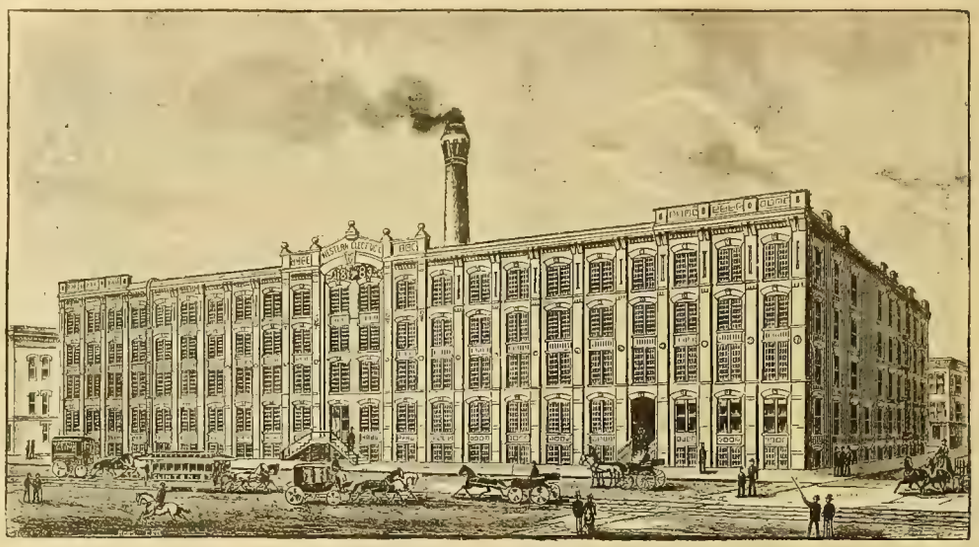
FARADAY CARBON COMPANY

PITTSBURGH, PA.

WESTERN ELECTRIC COMPANY,

Chicago. London.

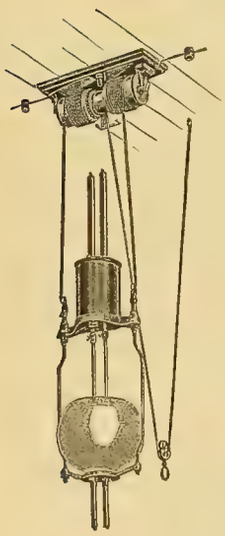
New York. Antwerp.

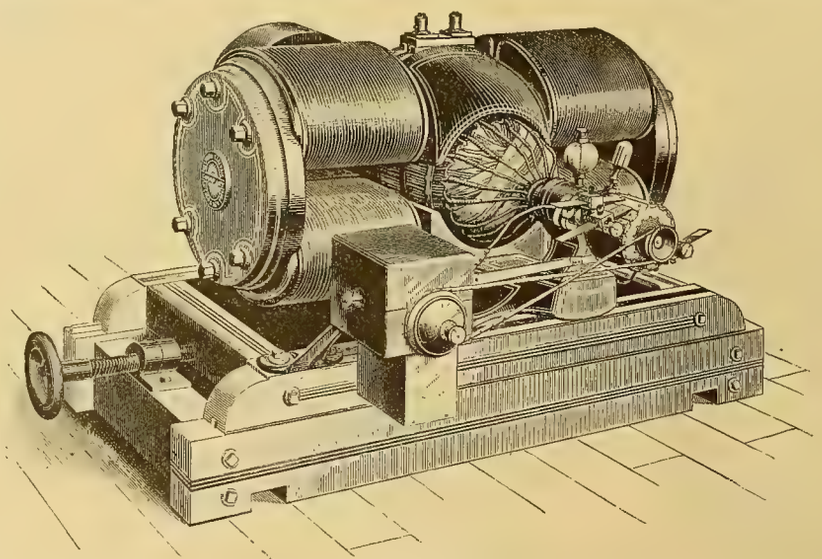


CHICAGO FACTORY.

Electric Lighting Apparatus

OUR SYSTEM OF ELECTRIC LIGHTING IS COMPLETE IN EVERY DETAIL, AND IS UNEXCELLED IN THE EFFICIENCY AND WORKMANSHIP OF THE APPARATUS, IN THE BRILLIANCY, STEADINESS AND COLOR OF THE LIGHT PRODUCED, AND IN AUTOMATIC REGULATION. WE FURNISH DYNAMOS TO GIVE ANY REQUIRED CURRENT. THE HIGH GRADE OF WORKMANSHIP AND THE EFFICIENCY OF OUR DYNAMOS





RENDER THEM SPECIALLY ADVANTAGEOUS FOR CHARGING STORAGE BATTERIES, FURNISHING CURRENT FOR ELECTRIC MOTORS, ETC. WE FURNISH ARC LAMPS ADAPTED TO ANY ARC CURRENT. THE SUPERIOR CONSTRUCTION AND SIMPLICITY OF OUR LAMP RENDER ITS USE ADVANTAGEOUS WITH ANY SYSTEM.

WE HAVE STILL A LARGE QUANTITY OF

KERITE WIRE,

Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even No. 16 gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes Nos. 13, 14, 15 and 16.

J. GEO. KAELBER, Selling Agent, 3 & 4 Duff Block, Denver, Colorado.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, FEBRUARY 25, 1888. No. 8.

THE CONVENTION

OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION AT PITTSBURGH.

The National Electric Light association convened in semi-annual session at the Monongahela House, Pittsburgh, Pa., Tuesday, February 21st.

We append a list of the officers elected for the ensuing term, a list of members and guests present, and follow with a stenographic report of the proceedings.

OFFICERS OF THE ASSOCIATION FOR 1888.

President—S. A. Duncan, Allegheny County Light Company, Pittsburgh, Pa.

First Vice-President—E. R. Weeks, Kansas City Electric Light Company, Kansas City, Mo.

Second Vice-President—A. J. DeCamp, Brush Electric Light Company, Philadelphia, Pa.

Executive Committee—Dr. Otto A. Moses, electrician, chairman; J. Frank Morrison, Brush Electric Light company, Baltimore, Md.; E. T. Lynch, jr., United States Illuminating company, New York; Frank Ridlon, Baxter Motor company, Boston; T. C. Smith, Keystone Electric Light company, Pittsburgh, Pa.; E. F. Peck, Citizens' Illuminating company, Brooklyn.

MEMBERS AND GUESTS PRESENT.

Allen, Arthur H.—Pittsburgh.
Ackerman, P. C.—New York.
Alexander, P. H.—Boston.
Adams, Geo. W.—Boston.
Acheson, E. G.—Pittsburgh.
Burnham, L. W.—Boston.
Butterworth, F.—San Francisco.
Bailey, Theo. P.—Chicago.
Baird, M. E.—Hartford, Conn.
Barney, C. H.—New York.
Bigelow, T. L.—New Haven, Conn.
Belote, Jas. L.—Norfolk, Va.
Badger, S. S.—Chicago.
Barclay, J. L.—Chicago.
Baxter, G. H.—Pittsburgh.
Beetle, G. L.—Chicago.
Blackwell, E. S.—Montpelier, Vt.
Brooks, David,—Philadelphia.
Butterworth, A. W.—New York.
Byam, N. H.—Pittsburgh.
Boulton, W. H.—Cleveland.
Baker, C. O., jr.—Newark, N. J.
Buckley, W. J.—Chicago.
Byllesby, H. M.—Pittsburgh.
Conkling, A.—New York.
Caldwell, W. W.—Nashua, N. H.
Caulkins, W. R.—Fremont, O.
Cartwright, F. G.—New York.
Colvin, F. R.—Baltimore.
Clark, Walter P.—Boston.
Cleveland, W. B.—Cleveland, O.
Curtis, C. B.—Chicago.
Cox, S. E.—Cleveland.
Curtiss, L. R.—Mendota, Ill.
Cram, H. B.—Boston.
Crouse, J. B.—Cleveland.
Candee, W. L.—New York.
Cullen, W. F.—New York.
Callender, W. M.—New York.
Curtiss, C. C.—Cleveland.
Duncan, H. E.—Boston.
Devitt, M. A.—Cleveland, O.
Dalzell, J. A.—Hartford.
Davis, Isaac H.—New York.
Dee, Jos. R.—Haughton, Mich.
Degenhardt, F. E.—Chicago.
DeLand, Fred—Chicago.
Dustin, C. E.—Hartford, Conn.
DeLong, Jos. C.—Utica, N. Y.
Dillon, L. M.—N. Attleboro, Mass.
DeCamp, A. J.—Philadelphia.
Davenport, G. W.—Boston.
Duncan, S. A.—Pittsburgh.
Edson, J. B.—New York.
Edgerton, N. H.—Philadelphia.
Eustis, H. H.—Boston.
Fox, S. J.—New Haven, Conn.
Forbes, George—London, Eng.
Frick, W. E.—Trenton, N. J.
Frisbie, W. M.—New Haven, Conn.
Greene, W. J.—Cedar Rapids, Ia.
Gates, J. H.—Pittsburgh.
Giles, W. A.—New York.
Giles, C. K.—Chicago.
Guilliam, Geo.—Philadelphia.
Godfrey, J. N.—Boston.
Garratt, A. V.—Boston.
Glasier, H. A.—Chicago.
Gormley, C.—Pittsburgh.
Hamill, S. M.—Cleveland.
Harding, H. McL.—New York.
Hayes, W. C.—Cleveland.
Hill, J. M.—Cleveland.
Horne, F. W.—Chicago.
Harding, W. H.—Baltimore.
King, F. M.—Baltimore, Md.
Knapp, M. A.—Chicago.
Kimball, W. R.—Montreal, P. Q.
Kinsman, F. E.—New York.
Kerr, W. C.—Pittsburgh.
Kreidler, W. A.—Chicago.
Lewis, E. N.—Chicago.
LaRue, Geo. W.—New York.
Leonard, H. Ward,—Chicago.
Longwell H. E.—Chicago.
Law, M. D.—Philadelphia.
Liebig, G. A.—Baltimore.
Lawrence, W. H.—Cleveland.
Lufkin, H. F.—New York.
Leggett, W. W.—Detroit.
Lynch, E. T., jr.—New York.
Larbig, Theo.—New York.
McKinlock, Wm H.—Chicago.
McQuaide, J. P.—New York.
McGonnigle, R. J.—Pittsburgh.
McTighe, T. J.—New York.
Magee, F. A.—New York.
Metzger, H.—Pittsburgh.
Moore, W. H.—Plainfield, N. J.
Moore, Alfred T.—Philadelphia.
Morrison, J. Frank—Baltimore.
Mason, F. A.—Bridgeport.
Manson, Geo. T.—New York.
Martin, T. C.—New York.
Moses, Dr. Otto A.—New York.
Mason, A. F.—Boston.
Mackie, Robt.—Ft. Wayne, Ind.
Miller, Geo.—Cleveland, O.
Marsh, J. W.—Pittsburgh.
McElroy,—Pittsburgh.
McDonald, W. B.—Ft. Wayne, Ind.
MacDonald, R. T.—Ft. Wayne, Ind.
McCarty, Norman—Baltimore.
Norcross, Perry—Janesville, Wis.
Nichols, E. L.—Ithaca, N. Y.
Newton, A. D.—Hartford, Conn.
Officer, T.—Council Bluffs.
Orford, J. M.—Bridgeport.
Pantaliony, G.—Pittsburgh.
Pratt, J. N.—Boston.
Peck, Edw. F.—Brooklyn.
Perot, E. S.—New York.
Parker, G. W.—St. Louis.
Powers, E. L.—Chicago.
Price, Chas. W.—New York.
Porter, Geo. F.—Pittsburgh.
Pentz, James A.—Philadelphia.
Phelps, Geo. M., jr.—New York.
Pope, H. W.—Elizabeth, N. J.
Patterson, A. H.—New York.
Russell, D. R.—St. Louis.
Redman, Geo. A.—Rochester, N. Y.
Rorison, Brainard—Indianapolis.
Ridlon, F.—Boston.
Ryan, R. W.—New York.
Ross, R. F.—Boston.
Royce, Fred W.—Washington.
Reckenzaun, Anthony—Philadelphia.
Rice, E. W.—Lynn, Mass.
Rohrer, A. L.—Lynn.
Sewell, Minot—Omaha, Neb.
Shay, J. H.—Chicago.
Smith, C. D.—Chicago.
Smith, T. Carpenter—Pittsburgh.
Smith, F. S.—Pittsburgh.
Smith, Jesse M.—Detroit.
Sperry, Elmer A.—Chicago.
Stone, Frank G.—New York.
Stump, C. E.—New York.
Shay, J. H.—Chicago.
Stanley, H. D.—Bridgeport.
Steuart, Arthur—Baltimore.
Steward, G. C.—Chattanooga, Tenn.
Slattery, M. M. M.—Ft. Wayne, Ind.
Schieren, Charles A.—New York.
Swift, W. F.—New York.
Schultz, J. A. J.—St. Louis.
Taylor, S. H.—San Francisco.
Terry, F. S.—Chicago.
Wetzler, Joseph—New York.
Weeks, E. R.—Kansas City.
Wainright, C. D.—Boston.
Warner, C. D.—New Haven.
Wills, Jos.—Nashville, Tenn.
Wright, C. D.—Petersburg, Ill.
Whitacre, H. H.—Wellsville, Ohio.
Wightman, E. G.—Hartford.
Wiley, G. L.—New York.
Wilbur, G. A.—Ft. Wayne, Ind.
Wyckoff, Frank—Williamsport.
Wright, A. P.—Springfield, Mass.

TUESDAY'S PROCEEDINGS.

The convention was called to order at 12 o'clock noon, by the president of the association, J. Frank Morrison, of Baltimore, who addressed the convention as follows:

PRESIDENT J. FRANK MORRISON'S ADDRESS.

Gentlemen of the Convention:—When the National Electric association in its wisdom decreed that its next meeting should be held in this city, it was certainly an evidence of faith in the stability of the business in which we are engaged. The cheapest of coal, natural gas, every element that nature could furnish for illuminating purposes, are here spread out freely without money and without price. To face these existing conditions the electric light, which is comparatively expensive, must have behind it the backing of nerve and courage and an unbounded faith in the good taste of the people of Pittsburgh, who, in spite of its greater cost have adopted in preference to its mighty competitors, that light which not only illuminates but adorns their dwellings, their mercantile houses, and their public buildings.

Seven years ago the first electric lighting company was started in Pittsburgh with 14 arc lights. It struggled along against prejudice and against time-honored usages for six years, at which time 300 lights were burning where there had been but one. Here a new era opened, and within the short space of eighteen months the electric lighting business increased to 350 arc, and 20,000 incandescent lights which now blaze in a constellation of glory, reflecting credit upon their progenitors. During the past six months we find that great progress has been made in cheapening the methods by which electric lighting is produced; this is noticeably the case in the arc lighting business.

The extension of arc lighting since our last meeting has been something marvelous, while even that has been outstripped by incandescent lighting, both by direct and alternating systems.

There are to-day in this country at least three thousand isolated arc or incandescent plants and over 1,000 central stations. At our last annual meeting there were in operation in the United States approximately, 125,000 arc lights. Since that time there have been installed and contracted for probably 50,000, bringing the present actual total within the neighborhood of 175,000 arc lights.

The number of incandescent lights at our last meeting was slightly over a million and a quarter. The installations and contracts made since that time are reported to foot up nearly half a million, bringing the present total to about 1,750,000, giving, it will be noticed, in the whole business a proportion of about 10 incandescent to one arc light. These are statistics which exhibit extraordinary growth and yet are conservatively estimated.

I beg again to urge upon the members of this association, the necessity of intelligent and well directed efforts toward the more perfect construction of lines and installation of apparatus. While some fatal accidents have marred the record of the past six months, I am glad to say that they have been fewer in number and less chargeable to the danger of the system itself than have been similar casualties in any other calling that involves the use of power-driven machinery. The attendance at this meeting is sufficient evidence of the success of this association. The secretary's report shows a membership of 168. By reference to the report of the treasurer, we find that a fairly good financial showing is made. With a debt of only $98.00 and with $971.00 in the treasury to cover all expenses of the present fiscal year, we need have no fears on that score.

Considerable progress has been made by Arthur Steuart, chairman of the legal committee, toward bettering our condition in the patent office. This is a matter to which your attention will be especially directed during the present convention and I ask for it your calm and careful consideration. You will be called upon to decide whether or not further steps shall be taken in the direction already pursued. I am seriously of the opinion that for the better protection of those engaged in the electric lighting whose first investments depend largely upon the validity of their patents we should, if it is possible to do so, prosecute to a successful conclusion a work so well begun by the legal committee.

Permit me to congratulate the association upon the excellent work done by Mr. Duncan, chairman of the executive committee, who has been so ably assisted by his colleagues, and who has shown his signal executive capacity by the excellent manner in which he has prepared for prompt transaction the business of the association, and for the comforts of its members.

I desire to call your attention to one or two points which reflect a great deal of credit upon the citizens of our own country, and perhaps, to put it mildly, negligence on the part of those abroad. Statistics show that in this country we have 178,000 arc lamps in service and also a large number of incandescent lights. Now the question naturally arises, why should we have made such headway on this side of the Atlantic and why should the business have been practically at a stand-still on the other side? The answer may be given in two words — vicious legislation. If one absolutely inimical to progress had planned an act of parliament which would have absolutely quenched electric lights in Great Britain and Europe he could not have better succeeded than those who framed that infamous act known as the "parliamentary lighting act," which has paralyzed that industry, has smothered invention in that direction and which finds its only vent in the spleen which casts slurs upon those of us on this side of the Atlantic who have been diligently engaged in procuring this light which has been so popular among all classes of our people. A few years ago it was only the rich who could enjoy this luxury. To-day it is brought to the door of the poor man's house and within a year or two more it will be the popular light which will not only take the place of the illumination by gas but will take the place of the coal oil lamp and will be within the reach of every one who is capable of reading, and who is desirous of using the electric light for that or any other purpose.

I now have the pleasure of introducing to you Major W. C. Moreland who will offer you the privileges of the city of Pittsburgh. Some of you took advantage of the privileges of the city of Pittsburgh last night, I think. Gentlemen of the convention — Major Moreland.

Major Moreland's Address.

Mr. President and Gentlemen of the Convention : I can not present myself in the shape of a bouquet nor can I hope to receive your flattering encomiums by my personal appearance. I regret that your convention is held on election day, when all the bars are closed excepting those to the hospitality of the people of Pittsburgh. I have been requested by the mayor of the city of Pittsburgh to give you a welcome to this city. To me it is a personal pleasure thus to speak—first, because I have a warm personal interest in all the men connected with the development of electricity in all of its parts, and because in this convention there sits a man who, forty years ago was my master and my boss—taught me how to carry a telegraph line—how to make a connection; taught me something about a magnet, a little bit about an instrument and asked me on one occasion to go—not very far from where we are sitting—to see whether the lines were not broken between two poles; told me how I could test whether or not the connection existed between those poles, by putting the two ends of the wire to my tongue. I did it, gentlemen, and fell over the hill. [Laughter.] I sat opposite him when the first telegraphic communication between New York city and New Orleans ever passed over this part of the continent. I heard him say that he had carried the wires through the marshes of Louisiana along through the whole of the south to Louisville, from Louisville to Cincinnati, from Cincinnati to Pittsburgh and at Pittsburgh he stopped to see whether the eastern connection was correct or not—my friend, David Brooks, the man who introduced electricity into the city of Pittsburgh, and made the first connection ever known in this country by wires connecting the extreme east and the extreme south. [Applause] I have, in addition to that, gentlemen, a personal pleasure in asking your attention to the industries of the city of Pittsburgh. If you have leisure to examine them, they are worthy of your study and we are glad that such a convention as this has assembled in our city, representing as it does not only experimental, but great brain power. You have solved the great problem that was in the mind of Benjamin Franklin who claimed that electricity was at last to be subordinated to the uses of man. You have brought it to our homes, you have brought it to our industries, and who can tell where with your industry, your brain, you perseverance, it may at last land? It has now become not a commodity but a pleasure, at our homes and fireside, and after a while it may be that we of to-day may be laughed at as being in the very incipiency of the power of electricity. Gentlemen, I have a personal pleasure in meeting you, not only because an old electrician myself—that is to say, a novice in electricity—but one who sympathizes with the progress made during the last thirty years of time, and secondly because you are right in the place where of all other places we want electricity practically applied. I know nothing about your purposes—nothing about the progress your society has made; but in the name of the city of Pittsburgh, as the representative of its mayor, I bid you a most hearty welcome and am glad to say to you that after the election is over to-day, every place will be open for the convention.

The President : I now declare this convention open for the transaction of business. The first business in order will be the reading of correspondence.

The Secretary read a letter from Geo. S. Bowen, expressing his regret at being unable to attend the convention; also a letter from F. C. Osborn, chairman of the committee on progress of the Engineers Society of Western Pennsylvania, inviting the members of the association to attend a meeting of that society at 8 o'clock in the evening.

On motion of Mr. Duncan it was agreed that the invitation be accepted and that the association attend the meeting of the Engineers Society.

Mr. Duncan : I move further, sir, that an invitation be extended to the Engineers Society of Western Pennsylvania to attend the sessions of this convention at their convenience, and participate, if they so desire in the discussion which may take place.

The motion was carried.

A letter was read from the Allegheny County Light company inviting the members to visit the station of that company. On motion the invitation was accepted. A similar invitation from the Westinghouse Machine company was read and accepted.

A telegram was read from H. C. Davis, president of the Electric club of New York, tendering to the association the use of the club house in the event of their holding the next convention in the city of New York.

On motion of Mr. DeCamp the communication was referred to the committee to be appointed to name the place for the next meeting of the association.

A letter was read signed by several Westinghouse subcompanies enclosing a contribution by those companies of $1,150 "to encourage the best interests of the association."

The communication was, on motion, accepted with the thanks of the convention.

The secretary read his report which on motion was accepted.

The report of the treasurer was read and accepted.

The report of the chairman of the executive committee was read by Mr. Duncan.

The President : The first business growing out of the report of the executive committee would be a motion by some member that what they have done shall be approved, and then we can take up their recommendations.

On motion of H. W. Pope the action of the executive committee was approved.

The recommendation of the executive committee, that delinquent members shall be notified at once that they are in arrears, and that they will be dropped from the rolls after the expiration of 30 days if their dues are not paid, was on motion adopted.

Mr. Duncan : I submitted in writing as provided by the constitution, and left with the secretary, an amendment to the constitution in regard to the question of dues. The dues at the present time, are an initiation fee of $10 and yearly dues of $10. It is very evident to the members of this association that for some time past the association has omitted to have its reports printed but the association has not had the funds to properly proceed with that work, and to print them as they should be printed, in pamphlet form; and it is only at this meeting that our funds are in such shape that we could possibly proceed with the work. The matter has given rise to considerable debate and discussion, and in order that it may be brought properly before the association at the right time I submit the following amendment to article 8 of the constitution : "That the yearly dues of the association shall be $20." I ask that the amendment lie over for consideration until to morrow morning, to be made the special order of business at our opening meeting to-morrow.

The President : Gentlemen, you have heard the amendment to the constitution. If you will refer to article 9 of the constitution, you will find that all amendments to the constitution must be presented in writing, and referred to a committee to be appointed by the chair, before being acted upon by the association; a two thirds vote of those present shall be necessary to their adoption; and that a ballot on such amendment may be called for upon the request of five members of the association. In pursuance of this provision of the constitution, I will appoint as the committee on this amendment, Mr. Duncan, Dr. Moses and Mr. Weeks.

Mr. Duncan : I desire to make a motion which was unanimously recommended by the executive committee—that Professor George Forbes, of London, England, be elected an honorary member of this association.

The motion was carried.

Mr. Lynch : I should like to make a motion for the appointment of a committee of five for the nomination of officers for the ensuing year, said committee to also make a recommendation to the association for the next place of meeting, the committee to be appointed by the chair.

The motion was carried.

The report of the committee on the insulation of wires and construction of plant, was read by the secretary.

A paper upon the same subject, by Prof. Thomson, was read by Mr. Rice.

Insulation and Installation of Wires and Construction of Plant.

BY PROF. ELIHU THOMSON.

I have been requested to present my views on the above subject, and having recklessly allowed myself in spite of the many other demands upon my time to accept the chairmanship of your committee on the same subject, I have felt it my duty to at least say enough to provoke a general discussion and interchange of views between others who may have given more special study to the matters in hand. My endeavor therefore will not be to arbitrarily lay down any rules, but rather to point out directions in which information may be gained and improvements made

The subject is certainly of great scope and could not be dealt with except in a very superficial way in the time at our command and meanwhile I feel constrained to state that I make no claim to the posssession of any of the qualifications which would be requisite for thorough work on the subject.

In the installation of the electric light or power plant, first of all we find that the conditions vary very widely. Its size, location, the distance covered, or length of circuits, and the climatic effects met with, need to be considered.

Then again the nature of the plant itself, whether arc light, direct incandescent, alternating system with transformers or converters, etc., governs to a large extent the conditions of the installation of the wires and of the plant itself. We may, of course, find in a single station or installation representations of these and other characters of plant, such as medium potential circuits for power transmission alone.

Three or four years ago we should have been required only to take into account simple cases of high potential for arc circuits and low potential direct currents for incandescent multiple are circuits, but the range now covered may be considered to be from any potential above 50 volts up to several thousands and any current strength from about one ampere up to several thousand amperes.

In considering the proper insulation and installing of wires for conveying these potentials and currents we are required to still further extend our field of view, and divide them into aerial, or overhead wires or conductors, and underground systems, and take each of these in connection with the conductors for indoor distribution to the lamps, motors or other energy used. We have thus outlined the the field which should be covered in dealing with a subject such as we have before us. Insulation and installation of wires and construction of plant would furnish as a subject material to fill a many paged volume and not by any means exhaust it. May such a work soon be forthcoming!

Concerning the relative merits of overhead conductors and underground conductors, it is pretty generally agreed that except for expense and difficulties of insulation, and connections from the mains, the underground system would be preferable as avoiding unsightliness, and liability of interference either by leakage, induction or contacts with the overhead wires. Now to preserve insulation of the lines conveying high potentials, which potentials cannot be avoided if distance is to be covered without conductors of such size as to have a prohibitive cost, is a vital question. It may well be conceded that when the potentials are very low, say 100 to 200 volts, the difficulties of insulation are very slight as compared with those of the use of two or three thousand volts.

It is a notable fact that so far as concerns the placing of overhead wires, particularly the wires of telegraph, telephone, and other such systems, and in some cases of electric light wires, extreme disregard of system or orderly direction for such wires is the cause of much of the unsightly appearance presented by them and much of the liability to get out of order. The tendency also is to use very light and easily broken wires for telephonic work, such as may at any time come down upon the necessarily stronger electric light wires, strength being synonymous with efficiency in these latter.

It is thought that there is need of some rules, or enactments to render impossible the mazes of telegraph, telephone, private wires, fire alarms, live wires, dead wires, and electric light wires, which, for our purposes, may be considered very live wires, such as may be seen in many of our large cities.

Should the wires of all kinds be laid or hung in orderly bundles having a definite direction and only changing that direction by definite angles, such as right angles, in accordance with a pre-arranged system, I think that much of the objection now existing to the placing of overhead conductors could be eliminated. Add to this a requirement increasing the durability and tenacity demanded for telephone and telegraph wires, and their supports and the damages of leaks and grounds would, in a large measure, be removed.

Many trials have been made, and considerable progress has resulted therefrom, in the direction of securing an insulating covering for electric wires to adapt them to the use of high potentials without leakage, and prevent contacts forming by abrasion with other wires. This appears to be one of the most difficult problems in electric engineering. The problem is not so much to find a first-class insulating substance for wire covering, but to find combined therewith, or to combine therewith the qualities of indefinite durability where exposed to the weather, and great toughness and power of resisting cutting or abrasion. For overhead work, not only is an excellent insulator capable of withstanding very high potentials without leakage or rupture required, but such property must be retained along with the mechanical properties of hardness and toughness, for indefinite periods. Besides the cost must not be too great.

To what extent any quality of insulated wire, or insulating material for outdoor use, fulfills this requirement, is a matter which it is difficult indeed to determine fully, particularly as a test for durability must necessarily require a long time for completion. Indeed, it would seem that our best guide must be the experience gained in the use of different wires on a large scale under different climatic conditions and without extremes of heat and cold more or less great.

Aside from the insulation given to the wire by its covering considered purely as an insulator, stress must be laid upon the requirement of resistance to mechanical friction or abrasion, as tending to give immunity from grounds by contact with other wires or with tree branches, roofs, cornices, etc. Toughness and elasticity of the insulation are hence seen to be qualities of high importance.

Whether such mechanical tests as will represent the conditions of actual practice in the use of the wire in relation to abrasion and percussion, bending, etc., which may break through the coating of insulation, can be devised and applied to test wires is somewhat doubtful, though, without doubt much information may be obtained in the pursuance of such an object.

The retention of the toughness and elasticity for a reasonable period, is, of course, demanded, and it is this retention which, in otherwise excellent coverings, is often absent, the effect of exposure being to render the materials brittle and porous.

It has often been proposed to make tests for the insulation resistance of the coverings of certain lengths of any wire, taken as examples representing an average for such wires, under potentials somewhat exceeding that existing in actual use or practice, and so to determine the insulating capabilities of different coverings, but it is my opinion that while such tests are certainly useful and important, and, in the case of underground wire and cables, indispensable, yet, for overhead work, since most of the length of the wire is exposed to air only, which is a practically perfect insulator, and since the chance of leakage from the lines arises mostly from imperfectly insulating sup-

ports and from accidental contacts with other wires or surfaces, additional tests would in any case be required to determine the suitability of an insulator for overhead lines. In this connection it may be stated that during thunder storms, overhead wires are subjected to violent inductional effects giving rise oftentimes, to the momentary charging of the lines with potentials very far in excess of the potentials of any demands, and capable of breaking through the wire covering where it may be near or touch a metal object or wet surface. This breaking through may give rise to a weak spot which will be followed by the dynamo current itself, if of high potential, and if at the same time other conditions be favorable to a diversion of current.

When overhead wires or pole lines are required to pass through and between branches of trees, a condition not infrequent in many of our towns and cities, considerable difficulty may be found in preserving the insulation of the line, the covering of which is apt to be rubbed off by the tree branches swaying in the wind. Fastening insulators to the branches for support and attachment of the wires is an uncertain remedy, on account of the swaying of the tree taking place in different directions not transverse to the line of wire so that the wire is strained or detached from its support along with the insulator by the violence of the action. Many and ingenious are the devices which the over zealous lineman makes use of to suddenly or gradually and mysteriously lop off the offending limb, when the case is exceptionally critical and permission for the amputation of the offending member can not be obtained from the conservative citizen whose sidewalk supports the obstacle to the lineman's ambition.

It is also customary to thicken the insulation of the wire at such places as are threatened by abrasion by winding on it a wide band of tough and adhesive tape such as can now be found in the market. If neatly and thoroughly done the insulation of the wire may thus often be preserved under decidedly adverse conditions.

It must be admitted that the insulation of a high potential circuit can never be too good and that therefore any measure which may tend to its improvement and preservation is a double advantage, for not only are the dangers of grounds and leaks lessened but the power of the current to do useful work is assisted. A considerable leakage from a high potential circuit means indeed a loss of power or efficiency of the system. For instance, the loss of one-half an ampere of current at a potential at 1,500 volts would represent about one horse power of current energy lost, costing more than a horse power at the dynamo pulley to supply such a leak. This latter consideration is of especial importance in dealing with the lines feeding transformers with alternating currents at high potentials.

With 1,000 volts in the primary circuit it is readily seen that a badly constructed or leaking line might easily cause the loss of a considerable percentage of current, such as would reduce the economy of the system more particularly when running under light loads, at which time it is desirable to secure and to keep up the best possible efficiency.

When wires or cables are to be laid underground their resistance to abrasion is of importance only when they require to be drawn into conduits or sections of conduits, but, when once placed intact, they are not necessarily further subject to mechanical injury, as they are generally surrounded by protective casings or tubes.

The total exclusion of moisture and the possession by the wire coverings of a high insulation resistance are requisites of great importance in such work. The difficulties with low potentials are comparatively easy to provide against, but in the case of wires at high electric potentials or pressures, such as arc lights or alternating current primary lines, such difficulties are much exaggerated.

The least access of moisture, such as may occur by flaws in the insulation, may result in the production of a bad ground; or a slight leak due to some original defect may so improve itself by the passage of current as to become a bad fault, or a complete connection to earth. It would seem best, in all cases, not to place reliance upon the integrity and perfection of but a single insulating coating or covering for the wire, but to give to it, say three coatings successively applied, and which are in a measure independent coverings, all of them impervious to moisture and good insulators.

If composed of different materials, the peculiar liabilities to defect of one such coating may possibly be compensated by other qualities in another coating, so that there may be small chance of superimposed defects in all coatings alike.

Let but the insulating capacity of each layer or coating be amply good to withstand the potential used, and it is difficult to conceive how trouble could arise from leaks due to defective portions of the covering. First cost is, however, a barrier to the perfection of underground systems, to save which cost, less effective and cheaper structures are often given the place which should be occupied by the more perfect and the more costly.

It is important that, in cases in which overhead wires, or wires above ground, are connected with underground lines, efficient means for carrying inductive discharges to earth be provided, such as is secured by the use of proper lightning arresters; for, faults may otherwise be produced in the best underground system of conductors due to static inductive discharges existing during thunder storms, at the moments of lightning discharge. These discharges are, in overhead lines, oftentimes quite vigorous, and capable of puncturing moderate thicknesses of insulation. They are not to be confounded with actual passage of lightning strokes to the lines, which of course have an infinitely greater capacity for mischief.

The preservation of the insulation of inside wiring is not difficult where the potentials used are low, nor is it difficult with due exercise of care and skill in the running of the wires and the selection of suitable courses for them to take, to install simple series lines, such as those for arc lights, which shall be practically exempt from leakage, unless abraded and brought into contact with conducting objects or moist surfaces involving leakage to earth.

Unfortunately owing to lack of skill and judgment, and haste in installing, much of the wiring done is not as well done as it should be for the best results.

Distribution of current to groups of incandescent lights upon arc light or other high potential lines should always be undertaken with great care, and it is thought that such work should only be undertaken when exceptionally favorable conditions for avoiding accidental leakages exist, especially should the potential of the line at the dynamo exceed 1,500 volts or an amount which would sustain thirty arc lamps in series. One of the important elements of safety in such installations is simplicity and ease of inspection of the wiring and no concealed wires should be used in them.

Concerning the wires which are suitable for indoor work and particularly for high potentials the endeavor has been to combine moisture proof and fire resistance, or rather incombustible materials in the covering. The difficulty has been to find moisture resisting substances which would not carry fire, and fire resisting or incombustible material which would not carry or absorb moisture. The two properties seem in most cases incompatible. The tendency now is to surround the wire with a first covering of moisture proof material of the nature of rubber, bitumen, resins, etc., and outside of this to place a second layer which will not carry fire.

For house to house and general incandescent lighting, where the distances from the station are not too great, the direct low potential system possesses most of the advantages, the difficulties of leakage from the defective insulation being, of course, at a minimum, but where the distances are so great as to make the required outlay for copper in the conductors practically prohibit the extension of the system, a transformer or converter system, if of good design and economy, may be made to yield excellent results. In such cases the high potential primary wires need not enter the building, or when they do may be suitably protected, the house or inside lines being of such low potentials as to be run with ordinary precautions as to leakage. However, the integrity of the system would be changed should a connection or leak form between the primary and secondary wires of the transformer, thus connecting the local or house line with the high potential outside mains. Such a connection might easily exist unsuspected, and would be a constant source of menace or possible danger, not discoverable by the mere tests for grounds as applied to the primary line at the station.

The expedient of securely grounding the secondary or local lines was devised by me to overcome this difficulty. It insures immunity from the risks arising out of possible leaks from the primary lines to the house lines, because such leaks are at once detected by the ordinary tests for grounds.

The consideration of the subject of what appliances are the best for the detection and location of leaks or faults in the insulation of conductors when they exist and whether the ordinary crude methods are adapted to all cases by such detection, would prolong the present paper much beyond its intended limits and it will have secured its object if it opens up an opportunity or gives occasion for a free consideration and in the interchange of experience and ideas upon the general subject forming its title.

THE PRESIDENT: The paper is now before you for discussion.

DR. MOSES: I have been informed that Professor Thomson being absent, the President requests that I, as the second on the list, shall speak on this subject. I feel like quoting a passage that I think will reverberate in all your hearts: "The boy stood on the burning deck whence all but he had fled." I do not see another member of that committee. [Laughter.] When that committee was appointed the president did me the honor to ask me to serve as the chairman, but for two very good reasons I declined. The first was—which he recognized when I declared it, and no doubt the convention did—that there were others more competent than myself to fill that place. Another reason was that I intended to return to Europe on some business that I had left uncompleted, and I did not know how long my business would detain me. In fact I was right, because I have but just returned. Within the last three days I received a communication from the chairman of the committee asking me for my opinion of the report which has just been read—asking my approval or disapproval. I gave neither the one nor the other, as the time was too short for him to receive my reply, and I expected to answer him at the convention in person. As he is not here and has kindly submitted to the convention a paper which embodies his own views on the subject, I believe that I should speak for the committee since they appear derelict in their duty. It must be borne in mind that a committee of solid men was appointed before this one was formed who did some preparatory work, but who declined to proceed further in the investigation without some money being put in their hands for experiments. But the president of our association, with his usual intuition, appointed a committee composed of men that had laboratories at their command. If my memory serves me, that committee consisted of Professor Thomson—we all know how admirably fitted up his laboratory is; of Professor Duncan, of Johns Hopkins university—we know how much care and time Prof. Rowland and himself have spent on that laboratory; Mr. Hamilton, of the Western Union, who has entire charge of the electrical outfit of the Western Union company; Mr. Lockwood, of the Bell Telephone company, known to you all by his writings and his active investigations in the direction of telephony; Dr. Waldo, who has had several university laboratories under his command, and Mr. Shallenberger, of the Westinghouse Electric Lighting company. All of these gentlemen, as you know, are fully equipped, and, gentlemen, he added me as a kind of "tail to the kite," I suppose, out of compliment. However, I gave my reason and he accepted it and put me as second on the committee—perhaps because I had refused the chairmanship. But I did not intend to take any of the work out of the hands of those gentlemen, because I knew that all the different branches of installation would be properly represented by them. There was the telephone insulation, telegraphic insulation, high current electrical insulation—general scientific treatment of the subject, so that the committee was formed for the purpose of getting an exhaustive report. Now the reasons that have been advanced by the chairman of the committee are very valid in some respects, yet, as I only received a communication but two days before the meeting of the convention asking my opinion on the subject, I am led to believe, though I have no absolute reason for saying so, that other members of the committee may be in exactly the same position as myself. They may not have received sufficient notice to enable them to give the report the attention it deserves. I do not feel as if that committee should be discharged. They are all good men and true. I am speaking for the others. I know myself to be true: whether I am good in that direction might be found out. I would suggest that the chair should be invited to reappoint them and to make any one of them the spokesman—not so much for furnishing a report, as is usually the case with chairmen of committees, but simply to be a head. There must be a beginning. We cannot make round robins in committees, but every member of that committee is able to do good work, and I think that the convention would be very much benefited by getting their experience, and I hope that the next report of this convention, which will no doubt be brought out in excellent style by the secretary, supplemented by the cash assistance that we received to-day, which will enable us to publish a fine report, will be furnished with a report on insulation that will be of benefit to this convention and that will be somewhat of an honor to American electricians for its thoroughness and fullness, and I hope that it may be a type for future reports that may be submitted to this convention.

MR. DECAMP: I agree with Dr. Moses in thinking that that committee should be continued. There is a great deal in it for discussion and which should be brought out in the course of some paper which could be presented to the association before the close of this meeting, which the members of this committee will have the benefit of, I suppose, when the reports of the association are published. There is a great deal in that report which will come under the head of our underground discussions as well as the report on our overhead lines. I will therefore move at the close of this discussion, if there is to be any on this particular report, that the committee be continued as it is, to report at the next meeting of the association.

The motion was seconded by Mr. Lynch, and carried.

MR LEGGETT: I wish to make a suggestion which occurred to me as this paper was read. That is, the effect upon a lead-covered cable of a short kink in the cable or of a dent in the lead — the compression of the insulation whereby the insulation is rendered a better conductor and so at that point there is a better opportunity for the current to leak out. I suppose that has occurred again and again to members of the committee. In the matter of insulation it seems to me that it would be a good point to consider. The case, of course, should be considered in respect to other insulations beside the lead covering. There is one other point that occurred to me in the reading of the report that possibly might come under the consideration of some other paper. I notice Professor Thomson refers to the high potential of the alternating current — whether that potential has been considered as high as it is reckoned—as one thousand volts — whether or not by the alternation of the current whereby at one instant there is no current, at the next instant a current in one direction, at the next instant no current; and then a current in the opposite direction — whether or not the potential instead of being one thousand volts is not five hundred volts. I refer more particularly to the action of the insulation — whether or not the conductivity of the insulation is not required to carry a current of five hundred volts rather than one thousand — whether it is not an average between no current and full current, and whether that does not account for the fact, which I understand to be so, that with the Westinghouse alternating current, they have under ground a number of their lead covered conductors with good results — whether the result is not due to the fact that there is less required of the insulation.

MR. RICE: If I am allowed to answer Mr. Leggett on that point I would say it is just about the other way. The potential that the insulator has to stand on a thousand volt alternating circuit is two thousand volts, just about double what would be on a direct current. That is occasioned by the wave going up for two thousand volts and then going down to zero. When you say two thousand volts it means an average of one thousand volts, and for a certain period of time that has to go to two thousand volts, making an average of one thousand. Perhaps the reason we do not have any more current with the alternating current than the direct, is that there is no active kick to speak of on a disruption of the line, whereas with a direct current there is quite a kick.

DR. MOSES: I am glad that Mr. Rice has spoken on the question of the excess of potential above the general average and also that Mr. Leggett has called attention to the fact. It is a mere hypothesis that the potential rises to two thousand volts, because in measuring those currents, Professor Rice will bear me out that he has never seen indications with an alternating current of a thousand volts potential. It therefore simply becomes a hypothesis. Because the current goes to zero and rises from zero it is supposed that the average must be one thousand and that the extremes should be zero and two thousand. But there is no evidence in that fact whatever. It is a surmise and it would be a very important thing for this committee to bear that in mind, and the secretary in making notes of these things would oblige us by sending to the chairman of the committee these points so that they may be worked up. They are very important to be known. I myself am pleased to hear that suggestion of Mr. Leggett that the condensation of a lead covered cable may act somewhat in the light of points in static discharge.

MR. LEGGETT: My point on that went a little further—the compression of the insulation itself. For instance carbon chips will form a very excellent resistance for the pas-

sage of the electric current, yet if you compress those carbon chips they become a good conductor. The question is whether the compression of the insulation by the kink in the wire or by the bend in the wire does not serve at that point to make the insulation a better conductor.

DR. MOSES: Perhaps the compression at that point will be extended as a pressure in the liquid, because these insulating materials are expanded and extend uniformly throughout the mass in the neighborhood of the compressed point, so that the pressure will be distributed very evenly throughout. In the telephone, for instance, when the carbon button is compressed, it is not impossible that the compression extents throughout the whole mass, and the multiplicity of points brought into varying contact produces the effects stated; so that the compression may thus extend through the whole mass.

MR. DECAMP: I cannot claim any practical or theoretical knowledge of this alternating current. I will simply put myself in the position of an asker of questions. I have generally understood that one of the difficulties in maintaining perfect insulation with direct currents is in the obtaining of insulation to cover a given number of volts and to provide against what I understand is the reactionary current arising from various causes. Dr. Moses states, and therein agrees with Professor Rice, that the alternating current runs from zero to two thousand volts.

THE PRESIDENT: Mr. Rice stated that the current ran from zero to two thousand volts, but Dr. Moses stated that that was a hypothesis, and that there was no proof of it.

MR. DECAMP: It is a case of "not proven;" but, do we stand convicted until it is proven?

THE PRESIDENT: The first proof will be on the part of Dr. Moses.

DR. MOSES: We stand as to that, as Faraday says we always should stand in the face of an hypothesis — with a suspended judgment.

MR. DECAMP: We shall have to hold that judgment in suspension until it has been demonstrated by every manager of electric lights that slight intermissions of currents are pretty sure to be developed by any reactionary current which is, intentionally or otherwise, created on that circuit. I think that is correct. That of course is not only liable but certain to be developed at particular locations, and it is likely to create others. It just occurred to me that if this alternating current is of that nature, that it is a constantly reactionary current — continually so — and hence my conclusion would be that the difficulty of insulating against that kind of current would be greater than that of insulating against a constant current.

THE PRESIDENT: Will you permit me to interrupt you a moment. A paper has been prepared by Mr. Shallenberger, entitled "The Energy of Alternating Currents." This paper will be read to-morrow; and this discussion will perhaps then be more appropriate than it is now.

MR. EUSTIS: With regard to underground wires I wish to mention a little result that came to my notice some time since which may be of some use to the convention Professor Thomson states that after the cables are once laid, they are then not liable to be disturbed, owing to the mechanical covering outside. But I know of one particular case in which the insulating wires were laid in a conduit, by a railroad track, in a box about six inches square. Three or four wires were laid in that loosely. Every time it rained, the water from the side of the tracks washed more or less through this conduit, and carried with it I presume, some sand. At all events, after the wires had been laid there about two years the insulation was found to be destroyed; and on drawing the cables out it was found to be due almost entirely, as far as outside appearances went, to the purely mechanical injury. The only explanation that I can see for that was the fact that as the heavy trains went over this conduit they compressed the ground, and the cables being — suspended, as it were — owing to its then stiffness, the two wires slipped by each other and gradually chafed the face of the two wires, one upon the other, and cut the insulation through. If any one has had a similar experience I think it would be a benefit to the association if he would state it.

DR. MOSES: I would like to ask if those wires were suspended or laid on the board.

MR. EUSTIS: They were simply laid loose.

DR. MOSES: Not only holding their own weight?

MR. EUSTIS: They were thrown into this box loosely; and they were undoubtedly full of kinks. My idea is that as the box gave from the weight of the trains, the wires being loose in the box, because of their own stiffness, would spring against one another, the two wires bending differently.

DR. MOSES: I would like to mention in connection with that some curious facts that came to my attention yesterday, and which were told to me while several members of the committee were being hospitably entertained by the gentlemen here. We were visiting the Westinghouse works, and saw a very large trip hammer; and when we were up in the cozy office, we could hear that hammer rebounding and shaking the foundations with a force that was quite terrific, One of the gentlemen cited a fact, and a very interesting one it is, to show how, under repeated blows material may be projected through a mass of other material. These slight vibrations might very easily cause the abrasion of the outer covering of two wires. If when the trip hammer falls upon an anvil an iron scale gets between that and the anvil, the iron scale can be forced through the body of the anvil and come out at the lower side, as is said to be the experience of many iron workers in Pittsburgh. It is a very interesting fact. I knew, that if a ball be put upon a solid barrel of resin it will, after a while, be found at the bottom, its weight acting upon the viscous mass, causing it gradually to descend through it. And the impression of certain strong intellects may be felt over very large bodies of men, by persistent action, as I know occurred in one very particular case that I will not cite. A fact which I had the pleasure of stating at the last meeting of the association is recalled. Among the cables of the Brooklyn bridge there are some hard drawn wires that are always carefully watched by the constructors of that bridge, because they are afraid that with the gradual stretching of the cable those hard drawn wires will be less effective than the softer ones, and ultimately so great a strain will come upon them that they will be ruptured. So that the very small action, long continued, may produce just the results that he speaks of.

MR. EUSTIS: In the cables I spoke of the abrasion took place for lengths of about six or twelve inches, at different places throughout the whole length of the wire, and extended a distance of something like fifty feet. There would be places eight inches in length, where the outside covering was completely chafed through, evidently from some change of that kind. What it was caused by we do not know. In other places the insulation was perfectly intact

MR. BROOKS: This slight jar or concussion can only be seen after a time. This matter was brought to my notice the other day by the Pennsylvania Railroad company They had laid three cables in a wooden box, along their railroad track. The boxes are four inches square, and fastened or closed; but it was found after a while that the cables began to give way. They opened the boxes, and they found that where they were laid on the bottom board of the box, the cables had worked by reason of this jar about half way through the board; and it had taken the covering off, greatly to their surprise, so that the insulation was in errupted. I have heard that in London, where they run the pipes on the overhead ways, even on those made of bricks, or of solid masonry, this continued jar will in time begin to affect them. So that it is well, when anything of that kind is laid, to have it away from anything like concussion, although the concussion may be but small in amount.

MR. SPERRY: Inasmuch as we have Mr. Sunny with us and he has a large experience in handling high potential direct currents underground; and as this matter of insulation is a very important matter, and anybody who can give us light upon it should be heard, I would suggest that he give us the benefit of his experience.

MR. SUNNY: My connection with the electric light business has been only for a short period. We have had some experience with underground cables; and I have made some memoranda indicating the results of our experience, which I intend to present when the discussion of underground cables comes up, as I understand it will in a day or two. I would like to state however, in reply to Mr. Leggett's question as to the effect of a dent in a lead cable, what the effects are upon insulation. We have to-day a large number of burn-outs in our lead covered cables; and I have been investigating a few of them. I find as a rule, the cable has burned out at a point where the surface was perfectly true, and where there were no indications of mechanical injury. On the other hand, in pulling out cables which have been destroyed, we have found portions of them where the mechanical injuries have been so great as to completely clean the lead off the insulation, leaving the lead bared. There was no indication, at the point where the lead was bared off, that any leak of the current occurred at that point. The facts that I have embodied in this short report are at the pleasure of the convention.

MR. LEGGETT: I would like to enquire whether the leak that is apt to occur at a point where the wire crosses above, or in the vicinity of steam pipes, or any other hot pipes, is one which would be caused simply by a difference in the expansion of the copper and lead, whereby one wire would be caused to force itself against the other, or compress the insulation between itself and the other.

THE PRESIDENT: If the gentleman will excuse me for interrupting him, I will say that a paper on the underground system will be presented by Dr. Leggett, and another, as I understand, by Mr. Smith; and this discussion will more properly come up after the presentation of those papers. I declare the discussion on this paper ended; and the next paper to be read is one written by Mr. Lange. As he is not here I would like Mr. Martin to read the paper of Mr. Lange.

Mr. Martin read Dr. Lange's paper on "How can we protect our watches from the influence of magnetism?"

DR. MOSES: That is an exceedingly interesting and valuable paper, and one which I think will be very much appreciated by the representatives of several of the largest watch companies in the world, who are now present. It was at the last meeting of the association referred to as a very important matter; and we are glad to know that Mr. Lange has been able to give us a means of overcoming the difficulty which is at once so thorough, so simple and so ingenious. I had intended to call attention to a fact which he has dilated upon. I have not read his report, but I knew that he was quite competent to handle the subject. The other day I had occasion to speak to a friend about an experiment that I had tried on the previous evening. I was in my bed-room, and took my watch off to place it upon the bureau, where there was a little compass belonging to one of my children; and I thought to myself that I would see whether the watch, which was said to be protected by a magnetic shield, would affect the magnet. Fortunately for the experiment as I approached the watch to one of the poles it was repelled, and thus absolutely proved that there was a permanent polarity somewhere in my watch. Had it been simply a mass of iron that acted upon the poles of the compass magnet it would have attracted it to either pole; but, after repelling the first pole I found it was repelled, which was proof to me of the magnetic polarity of some part of my watch. This watch of mine has given me a great deal of concern. It was presented to me on my twenty-first birthday, and I have carried it as a souvenir on account of its having made me miss several important engagements; and I will do anything in the world to demagnetize it. In 1881, while at the Paris exposition, I mentioned it to Mr. Varley; and he very kindly took it to an Edison dynamo, and turned it around in a way to reverse the polarity, which is equivalent to alternating the current, until he got away some distance from it; but still he did not demagnetize the watch. I could not understand the reason of this, but explained it to myself in this way: There was a certain amount of magnetism in my watch, every part of it being of steel, and that certain of these parts were lying parallel to the lines of force at a given time, and that they attracted the magnetism, and acted upon the hair spring balance wheel. But, to continue the statement of my experiment; I mentioned the incident to one of my intelligent friends in New York, and he said "show me that, because I believe that my watch is taken in the same way. It stopped suddenly last night, and this morning went on again." I thought it a very important matter if we could manage to get our time-pieces to going regularly; and it is quite evident, because of the reasons advanced in the paper which has been read that this should be so. So I said, "Let us see what is the reason." Said he, "I opened the case, some time ago, to see what was the matter. I found that the watch had stopped, and in order to see what was in the watch to make it stop, I opened it with my pocket knife, and perhaps my knife was magnetic." Said I, "Let us try it." So we took a needle, and floated it on a cork on water — that being a delicate compass needle with which to test for magnetism. He applied his pen knife to it but it did not work at all. So I said: "Who made your knife?" He said: "Rodgers," Said I, "I guess it is a pewter knife." "No," said he, "It is a steel knife" I looked at it, and sure enough there was Rodgers' mark upon it. I thought that I would show him how the needle would whirl around if a magnet was made to approach it, and so I took my knife, which I knew to have been made made magnetic by one of my children a short time before; and I brought that knife near the needle, but it did not budge. Said he, "I guess yours is a pewter knife." I said "Not at all; it is a Rodgers' knife too." I thought to myself how is this? I recollected that only the day before I had been between the poles of an alternating current machine. I had not tripped over it—as a certain gentleman says he tripped over a machine, and was thrown 15 feet away; but I was in the neighborhood of it; and probably my knife had been demagnetized in that way. The observations made by Mr. Lange in his paper more and more impress upon me the absolutely essential character of alternating currents for all distribution of electricity where we have to depend for life, or the safety of property, upon the compass needle. I think that that paper points to the abandonment of the continuous current distribution of electricity on board steamships. That is a very broad saying, but I think it will be proven, or supported by the facts that he has mentioned and that as soon as the attention of the owners of steamship lines is called to it they will investigate the matter and verify the statement by experiments, and that the result will be a change of the continuous current machines into machines producing alternating currents. That is a most important thing, and may be the means of saving many lives. I have had opportunity recently to see something of the carelessness of the officers and sailors on ship board in respect to handling the electric light wires when they are being moved out of the way. They do not seem to know what they are, or what they are doing. They do not consider the action of the currents upon the magnets that are entered there, or that the captain in his walks down the decks is relying upon the magnets for the direction of the ship. So that it is a most important thing that we should get rid of the possibility of the reverses of the polarity of compasses, or of the action of currents upon them at given times — in times of danger —and its effect upon the direction of the ship. So, I think that the paper which has been read will prove one of the most instructive to be found in our annual proceedings.

MR. SMITH: I would like to ask Dr. Moses what would be effect upon the ship of demagnetizing the compass. What mischief would it do?

DR. MOSES: The result would be that the ship would float around indefinitely; and they would find the needle following the movement of the ship, and going around as any needle would if you blew upon it. If, for instance, you attempt to float a needle upon water, and come close to it, you will find it darting off like bacteria, in all directions. It takes so little to disturb it when floating on water that so slight a cause as the breath, or the jar of the earth by closing a door, will move it

MR. KERR: I might mention the fact that there are about eight needles in a large ship's compass, and it would be hard to demagnetize them all at once.

MR. LAW: I quite agreed with Mr. Lange in his experiments and I may state that I have been considerably troubled with my watch. It has a shield on it; and I will guarantee that if placed side by side with any watch in the room it will interfere with that watch's movement. I mean any watch not properly protected. I have had considerable experience since the time of the Electrical exhibition in Philadelphia. While there I had demagnetized hundreds of watches by the old process of spinning them between the poles of the dynamo; but I had to be very careful in doing that not to do it as a man did who came into the station one night, and said, "I would like to demagnetize my watch," and he held it out to the dynamo—and soon after he had to pick it up all around the room. I went through that same experiment last week with Professor Houston; and the remarks which he made I wish to call to the attention of those who are investigating this subject. I will not state them in detail, but they refer to the old experiment of turning a copper disk between the poles of an electro-magnetic machine. That copper disk will produce currents which are called I believe Barlow's wheel. The supposition was that although the balance wheel of the watch was made of purely non-magnetic material, still if placed between the poles of the dynamo its influence would affect the balance wheel the same as it did the Barlow's wheel. the first experiment was to place the watch in the safe at the works for three weeks. It was a watch manufactured by one of the largest watch making concerns in the country; and it was purely non-magnetic. The action was perfect. It was timed every day by a reputable watchmaker. This watch was placed on the poles of a 30 light Weston machine and remained there for five minutes, without any effect. My own watch was placed by the side of it, and instantly stopped. Then the watch was placed between the poles of a Armout Hochhausen dynamo—a thirty light machine. The armature was taken out, and the watch braced up by wooden blocks, so as to come right between

the poles of the magnet, and directly in the strongest line of the force. We put that dynamo in a Daft circuit; the watch was placed in and allowed to remain there one hour. It lost fifteen seconds during the time. But understand, gentlemen, that the influence of the dynamo in this case was far more powerful than it would ever be called upon to sustain in ordinary use. I wish to call attention of those experimenting in that direction with a view of ascertaining if they have discovered any action on the balance wheel, even though it be non-magnetic, upon this old principle of Barlow's.

DR. MOSES: I would like to call attention to the first experiment ever tried and the one which led to the discovery upon which Faraday has built that immortal superstructure. Faraday found that the needle of his compass, a short needle, oscillated too quickly. Thereupon he had a heavy brass slate put under it. The needle diminished its oscillations about one-half in a given time, showing the influence of a solid mass of metal upon it—the result being, as afterwards proven by Faraday, the introduction of a current in a copper disk under which it would be acted upon by the current circulating around the magnet; so that no mass of metal oscillating in a magnet field will retain permanently the same number of oscillations per second that it had before it come into that field.

MR. GARRATT: I confess that Dr. Moses has somewhat frightened me, and I think that perhaps any one who has occasion to go down to the sea in ships and to do bus ness in the great waters might well feel alarmed if he were to assume that the great vessels, which are built of iron, which cross the ocean with their freight of thousands of lives and millions of dollars worth of property, stood in a very great danger by reason of the electrical appliances which they now have. I know nothing whatever from personal experience about the effect of dynamos and currents, and more especially the induced effect of currents upon navigation; but I am informed by a friend, an engineer of experience, and in whom I have confidence, that in some of the great ships, which are covered with a perfect ramification of wires, it has never been found that any influence whatever was exerted upon the compasses by the electric plant which lights the ship and does a part of the mechanical work upon it. In saying that, I do not wish in any way to reflect upon what Dr. Moses says in regard to the value of using alternating currents where they can be so used on board ship, or in other places where we must rely upon the magnetic needle; but it does not seem to me wise that it should go out of this convention that the present apparatus in use upon steamships is one of very great danger. On board the steamship Trenton the curves of that ship and its magnet were worked out almost every day for a time after the electrical appliances were put on board, but no variation of the compass needle or of the magnetism of the ship itself, or of any part of it, resulted, so far as the engineers, who very carefully investigated the matter, were able to discover from the dynamo plant which the ship carried. I want to say again that I do not intend that statement as a criticism or reflection upon what we all must recognize to be the very valuable remarks made by Dr. Moses; only I want to suggest that we are not in any great danger, the next time we want to cross the Atlantic, of fetching somewhere near Sandy Hook after we have started for Liverpool, simply because we have a dynamo on board the ship.

MR. SPERRY: I would like to ask the last speaker if it is not a fact that those compasses are provided with heavy masses of metal, thus forming a magnetic shield around the compass.

MR. GARRATT: I would be most happy to inform the gentleman, but he must remember that I put a saving clause in my remarks, and that was that I knew nothing whatever about the subject upon which I was speaking.

THE PRESIDENT: In order to reply to Mr. Sperry's question I will ask Mr. Colvin, who was an officer on board the Trenton, to state what the fact is.

MR. COLVIN: On most ships the compasses are surrounded by a mass of metal which acts as a shield. In the case of the Trenton (and I was aboard of her for some period) I had occasion to work those deviations of currents, and they were worked out on this side as they were in the Mediterranean. We would swing ship and take the bearing of the sun on every point, and every half point sometimes, with the dynamo going, and then with the dynamo not going; with certain lights in and with certain lights out; with lights going in the pilot house and lights not going in the pilot house. We had a torpedo apparatus there, of which I had charge, and the currents of that did not affect the compass at all. The ship's compass is composed of a number of needles of steel on the under side of the card board, and I never knew any variation in those curves that would amount to anything. The captain of the ship does not walk about the ship not knowing what his compass is doing. He knows more about that compass than he does of his own mind. It is worked out every morning, and every morning the captain takes a sight for the longitude and by that corrects any deviation of the compass, and so he is pretty safe.

DR. MOSES: This is a very interesting subject for the convention to dispute over; but I may say that I happened to be on board a French ship when there was a fire started which alarmed all the passengers and officers; and, although we were but a short distance from the harbor, we all felt very nervous for about an hour. One of the wires was torn out on deck. Now I would like to ask our friend Colvin, whether, if a wire carrying the entire current from the dynamo that was competent to supply five hundred 16-candle Edison lamps, was brought near to any one of the compasses upon which the captain depended, what would be the effect of that upon the compass—even though it might be surrounded by a very large mass of copper? Does he think that it would have no effect upon the deviation of the vessel from her course?

MR. COLVIN: In the case that he refers to the effect would have been that the quartermaster forward, and the quartermaster aft would notice that their compasses differed, and knowing that there was a difference the aft quartermaster would go forward and would steer by the forward compass.

DR. MOSES: I would like also to insert a saving clause. I said that the entire crew, captain, passengers and all, were in the highest state of excitement from the fire that was on board ship. We know some of the difficulties that would arise under those circumstances. Is it likely that there would be at such a time any comparison of the accuracy of the compasses?

MR. COLVIN: On a properly constructed ship—I do not know how it is in the merchant service, for there they sometimes save a good deal of money by not employing competent people—but in the naval service there are usually three people looking at the compasses at once—the signal quartermaster and two assistant quartermasters. As to your objection I will state that in the vessels on which I have been there has never been any spar deck wiring on the upper deck; it has been done with battens under the spar deck, and by the regulations of the department the compasses are put so far from any vertical line, and so far from a horizontal line; and the compass upon which they rely is usually some distance above the deck. All the other compasses could be lost or broken, and there would still be no danger on a properly equipped ship, or that that particular compass would vary so materially as to produce any disastrous effects. I am speaking now of the naval service; I know that sometimes in the merchant service things are, perhaps, carelessly or ignorantly done. Your suggestion is a very valuable one—about alternating currents, and one which I would take pleasure in communicating to the department; although, I am not now connected with the service.

The president appointed as the committee to nominate officers for the ensuing year, and to name the place for holding the next meeting of the Association, the following: Eugene T. Lynch, E. R. Weeks, Frank Ridlon, H. D. Stanley, and A. V. Garratt.

MR. DUNCAN: In view of our acceptance of the invitation to attend the meeting of the Engineers' society at 8 o'clock this evening, and as a further fact that our committees are to have a meeting this afternoon, I move that the association now adjourn until 10 o'clock to-morrow morning; as I think that we have done a pretty fair day's work.

The association then adjourned to Wednesday, February 22d, at 10 A. M.

WEDNESDAY'S PROCEEDINGS.

The association met pursuant to adjournment at 10 o'clock A. M.

THE PRESIDENT: The first thing in order this morning is the reading of the report of the legal committee, which will be read by Arthur Steuart, of Baltimore.

MR. STEUART: I have the honor to make the report of the legal committee upon the question of improvements in our patent laws. The legal committee was constituted some years ago, and has been working along in an effort to arrive at some intelligent results on the question of improvements in our patent system. We all know the intimate relations that exist between the electric lighting interests and the patent system of this country; how closely they are related; and how much the growth of the electrical interests is dependent upon the perfection of the patent system; and we all know from personal experience the serious effects and disadvantages that exist in the system as it is now administered.

Who can measure the benefits that this land has derived from the inventions which have been produced by its citizens?

Mr. Steuart then read the report of the committee and continued: I have thus presented to you some views with reference to the desirable changes and additions to the existing patent laws, which we desire to secure; and I have endeavored to show you the ground upon which are based these views.

I must also make a report of the work of the committee which I have had in hand during the last six months, in attempting to bring about the results which are here outlined to some extent.

At the meeting in Boston, held last August, the association passed a resolution authorizing the legal committee to introduce into congress a bill providing for the creation of a commission, to be appointed by the President of the United States, whose duty it should be to revise the existing patent laws, and report a bill to congress at its next session providing for such changes as they thought desirable. In pursuance of the preparation of that bill, and in looking over the ground to see whether the course was a desirable one, I was met on all hands and on every side by the earnest opposition of the ablest and most careful lawyers in the country, those most interested in the patent system; and they came to me with this proposition: "You are doing a good work; you are in a good line; but there is an evil that we can not escape; there is an opposing force that we must consider, and that is a deep-rooted opposition to the patent system as an element in our national policy that exists in some parts of this land. That opposition is represented upon the floor of congress by a great many members; and any bill which is introduced of this kind, opening the door wide to revision, may have the effect (and the danger is an imminent one) of giving opportunity to these enemies of the system to come in and do the system harm." As the result of that advice (and I found the sentiment which prompted it very general and prevailing) the committee determined to change its course of action, and not to introduce that bill, but to frame another. The question of what that other bill should contain has occupied the mind of the committee up to this time. It has not been fully determined, but it will be very shortly. For the purpose of arriving at a solution of that question, and determining what that bill should contain, and for the purpose of interesting the members of the association in the work of the committee, the committee entered into personal correspondence with every member of the association, and also with every person whom they could find who was directly engaged in the electrical business. I think that I do not draw it too strongly when I say that they have been corresponding with not less than one thousand persons throughout this country, and we have by that means been able to gather a mass of valuable information. The committee published a pamphlet, 2,000 copies of which were distributed among the members of the association, the members of congress, and among others who were interested in the subject. They have more lately published another pamphlet, 1,000 copies of which have been distributed throughout the country, the purpose of which was to interest those whom we could reach in this subject and get their minds into a condition so that when we were ready to present the bill we would be prepared to call upon them for their aid. I go from here to-night to Washington for the purpose of making arrangements in your behalf before the committee of patents in the house; and I have a memorandum here of several subjects which are now pending before the house committee, which it is our effort to oppose. For the purpose of looking after this question the committee have been partially instrumental in organizing in the city of Washington a bar association among the patent attorneys in Washington. That association embraces the most important men in the profession in that city; and, being on the spot, we look with great confidence to their aid in opposing anything detrimental to the system, and in aiding us very materially in our efforts before congress. When I presented the subject to them, I found that they were interested in it, and anxious to join hand in hand with us in attempting to benefit this system. The meeting which will be held to-morrow will be attended by a number of gentlemen whom I have notified, from different parts of the country; from Chicago, Boston, New York and Providence; all of whom will come to oppose the passage of certain bills which are now pending before the house. One of them is a bill which provides that patents, not used in manufacturing, but held to control the trade, shall be vacated by due proceedings and at the instance of anybody who wants to use that invention. A second measure is an "innocent purchaser bill"—which you are probably all familiar with—which protects a man who can not be proved to be a fraudulent user. The third bill gives to the circuit courts of the United States the power, at the instance of a would-be user of a patent, to take and examine the patent, and determine what would be a reasonable royalty for that infringer, or would-be user, to pay for the use of the patent, and to grant to him the privilege of using it without any restraint on the part of the owner of the patent. A fourth bill limits the right of the United States patent from 17 to 7 years. There are two other "innocent purchaser" bills, and two others which strike at the question which is now troubling telephone companies, and which may some day trouble you in your electric light business and that is the interference of state legislatures with the right of the patentee to use his patent, or the right of the owner of a patent to control the use of that patent. In Indiana the legislature has passed, as you are all probably aware, a law which limits the price which shall be paid by its citizens for the use of the telephone. That law has resulted, in many cases, in the refusal on the part of the company to permit telephones to be used at all, except on their own terms. This bill is now introduced (there are two of them) for the purpose of making it impossible for state legislatures to bind the owners of patents by such legislation.

All of these questions are vital questions, and they are questions which lie at the very root of the patent system. If any of these bills become laws the system will receive a very serious blow; and it is our duty in your interest to oppose their passage. At the same time that this meeting of the committee takes place to-morrow there will be a meeting for the purpose of opposing the passage of these bills and there will be a number of gentlemen in Washington, may of whom represent the electric light interests,—the Edison company having promised to send their counsel, the Consolidated companies will send theirs, and the Westinghouse companies will send theirs; and we will have gentlemen from various parts of the country all of whom are deeply interested in this question and in the effort to reform our patent laws.

The President has just handed me a memorandum which says that there are similar laws to this in effect in Indiana, before the legislature of our own state, which is now in session,— limiting the price for telephone service in Pennsylvania to the same rate as is fixed in Indiana, three dollars per month.

As I was saying, we will hold a convention in Washington to-morrow to discuss the question of exactly what is desirable, and in what essential particulars we shall move. We are all very well satisfied that our best chance of success lies in attempting very little, in narrowing our efforts down to one or two salient points, and concentrating our efforts upon those. The probability is that we will concentrate our efforts upon two points only: One, will be an increase of the salary of the commissioner of patents, to such a sum as will justify a man of sufficient capacity in holding the position long enough to be able to establish some practice in the patent office which would be satisfactory. The figures were given me the other day—I did not make the calculation, but gentlemen of eminence in Washington who have been familiar with the office for many years, have said to me that they made the calculation, and that the result is in finding that for 14 years the average time of the commissioner of patents has been but 15 months. When you consider that each one of those men has gone in there with comparatively no familiarity with either the laws or the practice of the office—with some few exceptions, for some of them have of course, held office for a longer time and some for a shorter time—when you consider that each of these who have gone in there have gone in with but little familiarity with the subject you can understand how perfectly chaotic must be the condition of the rulings and practice of the patent office. That will probably be one of the points upon which we will concentrate our efforts. A second will be to establish an intermediate court of patents, which will hear appeals from the circuit courts, and also from the patent office. This is the work which the committee now have before them.

DR. MASON: So far as I have been able to learn, the efforts and the discussion in previous sessions of this association on this subject have been with the object of confining the work to be done exclusively to those who are interested in electrical matters. Am I right, Mr. President, in this supposition—that the work and plan of the convention, mainly, if not entirely, has been confined to those who are interested in electrical matters?

MR. STEUART: Yes, that was the case until we organized the present Bar Association at Washington, which represents diversified interests.

DR. MASON: It strikes me that it would be well to reinforce ourselves by an effort to gain the sympathy and co-operation of the different societies of engineers in this country, who, if not equally interested with the electrical association, and with electrical gentlemen, at least have a profound interest in this same question, and who would probably be glad of an opportunity to work right along in the same line with us. I wish to throw this out as a suggestion; and then to make a remark which will be rather in the form of a question. It seemed to me that at one point of the paper read to us it reflected upon the intelligence or the culture at least, of the examiners and assistant examiners in the patent office. I would suggest that a thorough acquaintance with the history of the men who are now the examiners and assistant examiners in that office would develop the fact that a large proportion, if not the majority, of the examiners and assistant examiners either have been admitted to practice at the bar, or have been graduated in schools of law. I wish to throw this out as a suggestion. I think it might be as well, in a paper issued by us, not to reflect upon either the intelligence or the culture of the board of examiners and assistant examiners.

THE PRESIDENT: I do not see how you can present a paper in this association without reflecting upon them. If there is nothing wrong, then there is nothing to right.

DR. MASON: We might reflect upon the system, but not upon these gentlemen.

THE PRESIDENT: Perhaps that is so; but I think that you will have to reflect upon both of them before you get through.

MR. LEGGETT: I dislike to arise in opposition to a measure of this character, but, from the very outset of this action on the part of this association, it has struck me as a piece of very bad wisdom—a thing which we ought in a very quiet way to abandon. Now, every one of these questions which were raised by Mr. Steuart in his article (a very excellent article by the way) are questions which affect not electric light companies, but the manufacturers of electrical apparatus. There is scarcely a manufacturer in the country that is not willing and anxious perhaps to change certain features of the patent law; and yet I doubt very much, from the experience which I personally have had with manufacturing interests, that they desired the system to be attacked in a general way. We have a patent system which is by far the best of any system on the face of the earth. There is no question about that. Canada has followed it, and has made a patent law almost identical with ours. England, which has had a patent system for one hundred and fifty years, and perhaps longer than that, has followed ours within the last three or four years and has patterned almost word for word the principal sections of our patent law. Germany, advanced in all these matters of patent law, and in material interests of this character, has followed, within the last three or four years, with a new patent law based almost word for word upon ours. Belgium is seeking the same pattern to copy from, and so the result of the patent law of this country has been the development of industries of such magnitude that it has been copied in the laws of all nations; for all nations are coming to adopt the same basis in this matter; and it therefore seems to me very bad policy at this period, when there is agitation against certain features of the patent law to raise the issues which are now suggested. Many of you will recollect the action which was had a few years ago, on what was termed "bill 300"; and at that time, as some of you may recollect, a bar association was formed in the city of Washington with a view of dealing with this matter. It may have gone into a condition of "innocuous desuetude"; but I think it was never formally disbanded. That association, it is safe to say, together with its ramifications throughout the industries of this country, was able to collect and expended probably a hundred thousand dollars at that time in an effort to amend the patent laws. Every feature which is here raised was raised at that time, I think, without exception. The bill passed into the house and into the senate, but there was no possibility of getting it through. Now, I know that there are certain features which have crept into our patent system, and which frequently have been the subject of inquiry, and doubtless will continue to be among the difficulties of the system, and one of them is how to remedy suits against users. That is where the prejudice had arisen all over this country. The drive-well suits, of which thousands were brought throughout the country: and another litigation in which I was the attorney—the Birdsall-Clover huller cases. We brought over a thousand suits in this country; and I had the pleasure of having the bees come about my ears for years, in connection with these suits. It is folly to pursue the larger manufacturing institutions to stop infringements. The remedy seems to lie, in that respect, in a measure which would reach the corporations. It is a very simple thing for a manufacturer to go to patent counsel, or to proper authority, and have a search made, which will determine absolutely whether the thing which he is about to make is going to infringe a patent. But, instead of doing that, the corporation takes up an invention, goes ahead and makes it, and puts the article out all over the country, and the users buy them innocently, while the real inventor is defrauded out of his rights by the fact that the whole market is taken possession of, and he can not tackle these powerful corporations. The same matter has been corrected in many countries. In France, for instance, the infringer is punished by fine and imprisonment. First, by fine and forfeiture; and not only a forfeiture of the infringing articles themselves, but a forfeiture of the machines and tools employed in making them, for the benefit of the patentee. A second offence is punished by fine and imprisonment. In Germany, in Belgium, in Russia and in Sweden it is the same. In Spain the measures are still more stringent. In Italy, in addition to fine and imprisonment, there is a clause to the effect that no action shall be delayed for more than one week. Laws of this character, making the infringement of a patent an offence punishable by fine and imprisonment, stops it at its inception. The manufacturer does not go into the business. He keeps out of it; and consequently suits against users are unknown. The protection of property in patents is recognized and enforced. Now, in order to strengthen the law of this country in that respect, it is necessary to build up the wall around inventors, and not tear it down. But this is a matter which affects the manufacturing interests, and not our association interests solely. It seems to me a matter in which a hundred thousand dollars was expended not later than 1877 and 1878, in a futile attempt to mend these special features of the patent law, it seems to me that in such a matter that it would be poor policy for this association, where not one single interest is involved, to go ahead and expend the little money that we have on hand to seek to carry out measures of this character. I do not believe it is good policy. I do not believe the move reflects the sentiments of the different interests in this association. I think that this matter was proposed to us and carried through without sufficient thought. We are launching upon an investigation here which has no end. What have we to do with the matter of promotions in the patent office? What have we to do with the question of the compensation of the commissioner? These are things in which the patent attorneys in associations where large manufacturing interests come together will reach a conclusion, and that conclusion will be satisfactory to all. I think, gentlemen, that when this discussion is about to end I will offer a suggestion, perhaps in the form of a motion, that this association lay this matter upon the table, and expend no more money in it. I would like to hear other gentlemen express their views upon the subject, if they have any.

MR. STUART: If I may be permitted to make a remark in reply to the gentleman who has just spoken, I will do so. His suggestion is that we are opening a wide field in an apparent effort to tear down the walls of protection which surround the patentee. I am sorry if I have expressed myself so obscurely. I am sorry if I have not made my meaning clear in my effort to suggest that the whole purpose of this committee, the whole purpose of the effort which has been made, has been to build up around the patentee every safe-guard and every weapon of defense against infringers that could possibly be devised. That has been our purpose solely and entirely. Our effort is to protect the patentee, to strengthen his patent right, and to give to the owner of a patent a right that will be far more valuable than any right which he now possesses — and particularly in relation to electrical matters. With reference to the gentleman's suggestion as to the advantages which our system has over other systems, I wish to say that I fully appreciate those advantages. We have the best system in the world; and those countries that have followed us,— Germany, England and Canada, particularly Germany, which has followed us most closely, have carried our system to the very point beyond us to which we want now to carry it. The last thing done by the German government in perfecting their patent system has been to establish a court especially for patent appeals, and to put over their patent office a man who will hold his position during a long term of years, sufficient to enable him to understand the practice, and to dictate proper rules to the examiners who are under him. That is what we seek. That is all that we are now seeking. It is simply to carry forward our system so as to complete it, and put it where our imitators have already gotten theirs. They have carried it beyond ours in theory. With reference to the effort which was made ten years ago to alter or amend the patent system,— the gentleman has suggested that an effort was made in which a hundred thousand dollars was spent, and which was unsuccessful because, as he intimated, it was impossible to make any changes. I would like to read a clause from a letter which I have in my hand from James J. Storrow, whom we all know, of the Bell Telephone company, on that subject. He writes:

"Ten years ago an attack was made upon the patent system, as you know, by an organized company of infringers. The best that my associates and I, representing a large amount of patented property and interests, could accomplish was to agree to some modifications which we thought were wise, and would tend to remove some features of the law which we had to admit however were very obnoxious, and to agree in a modified form to some others that we thought would have passed in a worse form if we did not come to an agreement about them."

The facts with regard to that effort were, that it was an effort by a band of infringers who were determined to break down the patent system if they could, or to introduce features into it which would enable them to use certain patented pr perty which they wanted to use, free of charge, and free of liabili y for infringement. A hundred thousand dollars was spent, but it was spent to a large degree, in defense of the patent system against the attack of the infringers. At present we propose, although there are many suggestions made, but those suggestions are made for the purpose of gaining light upon what is the most desirable thing to do, at present we propose, and have settled down to the conclusion, as I have suggested, that we will do just what Germany has done; we will put over our patent office, if it can be done, a man who is thoroughly capable of managing it; and we will establish an intermediate special court of patent appeals, with jurisdiction to hear the technical questions which now go into our courts, where there is, in many cases at least, an entire absence of technical knowledge. We are attempting to build around the patent system and around the patentee a wall which will be a benefit to every member of this association. Indeed, I can hardly conceive how any association that has existed in this land could be more interested in this subject, or could more properly be said to be the right source whence efforts of this sort should spring than this association.

DR. MOSES: Referring to the remarks of Mr. Steuart, I would like to mention an incident illustrating the efficiency of the superior court in Germany. A friend of mine who represents a very important patent abroad for electric motors, was recently laying that motor before various manufacturers in Germany, for the purpose of uniting with them in the exploiting of the invention. He met one of the largest manufacturers—who shall be nameless, although his action should be blazoned abroad so that we may know what some men can be capable of doing when they have the power to do ill. This manufacturer said to him: "That is a very good invention, indeed; but if I want it I will use it"—in those very words. My friend thinking that the gentleman was, so to speak, on his own dung-hill, and had the idea that perhaps he might do so, thought that he would investigate the question; and on doing so, he found that this appellate court would not only protect him, but would take cognizance of such a remark. It is a bad spirit, it is a freebooting spirit, and ought to be repressed as much as possible A patent represents a concrete idea, an accumulation of mental wealth, that a man is entitled to hold and to have just as it were hard dollars. He spends hard dollars in exploiting it and perfecting it, not to mention many sleepless nights. Now, if such a law as Mr. Steuart proposes can be brought forward, so that we could have such a court, there would be a greater dignity attached to our patent system. As it is, the American system, excellent in many respects, commends admiration abroad for the very thorough manner in which claims are investigated in the patent office. I have heard many compliments paid to it by distinguished patent lawyers.

It is well not to touch a crumbling structure for fear that you may precipitate ruin upon you; yet, at the same time, we put in all sorts of tie bolts, in order to keep it in position temporarily. These tie bolts should be, in our system, an avoidance, if possible, of those extraneous matters which rather tend to weaken the confidence that the patentee has in the security of his right. It would be a very wise thing for us in some way, as a body, to call attention of the legislative branch of the government to the fact that we are willing to co-operate with all other branches of inventors, or societies that represent inventors, in order to give a greater stability to the patent laws, and greater protection to inventors. That course I think is very admirably outlined by the committee who had it in charge; and I hope that we will give as much moral support as possible to these gentlemen in the very arduous, but not a thankless task, because they will have the reward of our praise,—in a very arduous but most useful effort; because it will tend to give greater security to the American inventions which are now, particularly in our branch, the fundamental ones at the bottom of the greatest industry that has ever been started,—and that is the electric light industry.

MR. PHELPS: I share with Mr. Steuart in his surprise that the work of this committee, or any action of the association upon it should be construed as being in any manner an attack upon patent protection, or the patent system. I suppose it is quite within the truth to say that the movement was conceived and started purely for the purpose of conserving all the protection that inventors now have, and clearing up as much as possible the obscurities that exist in relation to inventors' rights, by better methods applied to certain portions of the system as now practiced. I think there can be no doubt about that. I was also a good deal surprised that any one should fail to see the very immediate and direct interest that all the members of this association as well as manufacturers, have in this question. It seems to me that the conclusion which exists in respect to the relations of many patents to one another and the rights of various people with respect to one another, is a source of constant anxiety to nearly every one engaged in the electric light business. I think that the work of this committee has been fully justified, and the time spent upon it has been fully justified by the results that have been reached up to this time. If I understand our position now, we are expected to pass upon the suggestions made by the committee, for I suppose that the remarks of Mr. Steuart made after reading the report of the committee as presented in the printed pamphlet, are to be considered also as the report. The proposition, as I understand it, is to entirely abandon the idea of the creation of a commission, and instead of that to direct the energies of the bar association of Washington, supported by an expression of opinion as evidenced by a vote of this association, towards the accomp'ishment of two distinct measures: The creation of an appellate court, and the increase of the salary of the commissioner of patents. Both of these measures seem to me to be quite free from the objections which would attach to any measure which visibly showed the object to be the increasing of protection to the patentees. Probably all the members of the association, or a large portion of them, have recognized the danger of introducing any measure which should seem obviously to be addressed to the increasing of the value of patent monopolies in a money sense; but these measures simply look to conserving the rights and the protection now afforded by our patent system, by a modification of the methods of administering patent laws. The measures suggested, as they seem to me, do not afford an opportunity for attacks upon our patent system, and it would be difficult to make amendments to either of these proposition which would attack the patent system. Therefore I trust that the association will see fit to indorse the proposition of the committee as I now understand it to be.

MR. LEGGETT: I think I may be misunderstood if it is inferred that I assume that the action of this committee is in the nature of an attack upon the patent system. I do not consider it an attack in any way, shape or manner. I think that the recommendations of the committee, in most respects, are good, and that they will correct abuses in the particular channels indicated. The point with me is simply this: Is it policy for this association to divert its funds (which are very limited, to say the least, although we now have a proposition before us to double our dues,

in order to carry on our business properly)—is it policy for us as an association to divert our funds into another channel? Now, if there are persons here in this association who desire to further the ends suggested, if there be manufacturers with us who have these ends at heart, and if it is for their advantage that these recommendations should be carried out, let them act personally and individually to advance the object which they desire; let them join this movement; let them divert their own funds into that channel; but, of what earthly use is it to an electric light company to interfere with these matters in the patent office? It seems to me that there is no interest in this country that has been so well served in the patent office as the electric interest. I do not think that a set of patents has ever been issued in any country that will compare with the electrical patents which have been issued in this country. Why, the Bell telephone patent — a patent obtained from our patent office—has withstood attacks in all the courts of this country; and even an action by the government itself to annul it cannot reach it. If we look at the foundation patents of the electric light companies we find that they also are very admirably drawn. All of these inventions, right straight through, so far as the electric interests are concerned, have been conserved in the patent office, right straight from the very beginning to the end. The only point I make in this matter is that as an association, let us simply suspend our operations at this point, and recommend if necessary, or if thought desirable, that the individual members of the association be requested to lend their efforts, so that the association funds may remain intact for the use of the association. If this thing is to go on you will have to spend thousands and perhaps tens of thousands of dollars before you will know where you stand. I recollect that at the time "bill 300" was under consideration that a party gave me sixty dollars a day for more than two months to remain in Washington and look after his interests in connection with that bill; and it was not very large compensation either. I know of attorneys in this country, who are paid two or three hundred per day for four or six months—Mr. Starrow, for instance, who represented large interests at that time. While it is true that there was an attack by an organized band of infringers, still it was based upon those defects in the patent law; and thereupon the patent association got together, not to attack this band of infringers, but to correct the features of the patent law which were present. We are not called upon to-day, and there is no reason why we should fear an attack upon the patent system. We are not here to protect or to attack our patent system. As an association we have not been called upon to do that; and I do not believe as an association, that we have got to go into that matter; for that will still be attended to by patent attorneys, and by those who are more directly interested in patent matters. Every interest of the kind in this country is represented and looked after by those who are prosecuting these matters in the patent office, and their expenses are sufficiently paid for the pupose. From the reports of every commissioner for years past, away back at least to the time of Commissioner Mason, every commissioner has recommended, right straight through, the reformations which are suggested in patent matters. It is not a new thing. They have been striving year after year, since that time to accomplish these purposes; and I do not think we ought to stand up here now and take the brunt of that thing, and pay from our association fund the money necessary to carry such measures through. I simply suggest, as matter of policy, that, as an association, we drop this matter except so far as our recommendation goes; and then, as individuals, let us carry it so far as each individual interest deems it to be appropriate,

THE PRESIDENT: Up to the present time the money expended by the legal committee has not been taken from the funds of the association, but has been contributed by voluntary subscription by the representatives of different interests, and there is now remaining of that special fund about $250.

MR DECAMP: That appropriation was made for two purposes—to meet the expenses of the committee, and to procure the publication of our proceedings. The fund which was contributed for those special purposes has already been half expended; the balance is in hand for use for that purpose. If Mr. Leggett will allow me, while I am on my feet, I will say that while I am in entire sympathy with the revision of these laws, as stated by Mr. Steuart, I think that we are taking hold of something that we cannot carry out. I think that we will find that the fund required for that purpose will be very largely in excess of what we are able to pay. The small balance of $250 which remains out of that small contribution is sufficient probably to pay the expenses which have already been incurred, and to meet bills to be presented for outlays which have been made. I, for one, do not see how you can carry it any further with our finances as they now stand.

MR. GARRATT: We are undoubtedly much impressed with the arguments which have been advanced, and especially by the statement of the large fees which patent experts have received. It does not seem to me, however, that this is the time to abandon this particular subject. It was my misfortune not to have been here when the discussion was opened; and there is one fact which may then have been mentioned, but which I wish again to mention, but without making any argument upon it; and that is that on the 20th of last month there was presented to congress a bill drafted for the special purpose of wiping away our present patent system as it now exists, and going back to the patent law as it was in 1796. It does not seem to me appropriate that, with the interests which we have at stake, we should be inactive in this matter. I own a good many patents; I do not know as they are worth anything, but yet I feel that I have some interest in this matter. It is argued that we are here for no particular interest; but we may some day be fortunate enough to get hold of something which is worth something; and it does not seem to me to be wise to drop this matter. It has been argued that it will take a large amount of money. It has been argued that suitable experts must be remunerated in a way not commensurate with our means. I would remind the association—and I do not do it because the head of the patent department of this association happens to be a friend of mine—that there has been very much work done here which has cost the association not one cent. It is a common custom for those at the head of a committee to do nine-tenths of the work, and to do it without remuneration. There are other committees, or have been in this association, composed of gentlemen who you well know have been called upon to devote long, hard, persistent work—professional work—without remuneration,—which otherwise would have been paid for; but the service has been given as freely as the wind blows over this house. I have no doubt that if it is the opinion of this convention that this movement should go on, the funds will be forthcoming which will not leave this association under any great encumbrances of debt. This bill which I speak of as being now before congress I do not think will amount to much because I happen to know that at the present time it is not backed with very much power; it might be. It is a bill which might be promoted by an organized system of infringers, the same as the previous effort which was made some ten or more years ago; and it might then become an element of very great danger to us all. I do not want to see a blanket of cold water thrown over this movement in the face of facts as they now stand. There is one more point to which I wish to refer. There has been an argument advanced here this morning that the electrical interests have been advanced by the patent system as much as any other interest. That argument was followed by a syllogism; but that syllogism was a false one logically. I do not cast any imputation upon the intent of the man who advanced it; but electrical patents and electric light patents were used as one term of the syllogism interchangeably. Such logic as that is not permitted in courts, and ought not to be permitted before this association.

THE PRESIDENT: There is one point that I want to say something about in this connection. I do not know anything about the legal phases of this question; nor about any of those outlying ramifications which have been discussed by the gentlemen who have spoken on this matter. That which I wish to call attention to is the fact which has not been commented upon by any of the speakers; it is that the men who are using these patents, the men who have paid their money for these patents, have found them in a great many instances absolutely worthless. Now, there are patents, and there are patents; and while Mr. Leggett has held up to you the wonderful success of the Bell telephone, which I believe has had more piratical attempts upon it because of its success than any other patent ever obtained in this country, he has brought in collaterally the protection which has been afforded to our business. I maintain that a proper system in the patent office—and I want you think this over after awhile—would make a patent issued from that office just as good as gold, if the system was proper and if proper safeguards were thrown about it. I want also to make this statement, that, throughout this broad land where millions of millions of dollars have been invested in the electric lighting business, there have been very few, if any, favorable decisions in the courts of this country in the electric light patent suits. I am inclined to draw it very mildly. I do not want to make any extreme statements. I know that when I get to talking I generally put the bad end foremost; for, I want to make my case as easy as I can. The result of that has been—what? It has been that the promoters of electric light companies go into various communities in which they live and solicit their fellow-citizens to put their money into the electric light company. When you deal with a parent company its representatives will say to you, "We have the foundation patents; we have property here; we are not offering you a paper upon which is written down a number of set phrases and words; but we are offering to you something which is just as good as gold, because we are going to take your gold for it." But what has been the history of these cases? I do not want to reflect upon any representatives of parent companies who are here; but the melancholy fact stares us in the face—melancholy to those who have put their money into electric lighting companies and have got no return from it—that infringers are men who they claim, when they were selling their patents were infringers, came into your territory and established themselves cheek by jowl with you; and the result was that you found yourself in a few months doing business for nothing; and a promised decision in court was never delivered. Decisions are rarely ever reached in electric light patent suits. Therefore the purchaser of the patent suffers. The parent company with all this gilt edge work thrown about its business, sells you what? It sells you these patents. Why do you buy them? You think that you are investing in a property which will bring you a good return for your investment. But what do you find? You find that there is no punishment for the so-called infringers. You find that your patents are comparatively worthless. Why is this? Surely the inventor believes and has faith in his invention; surely the men who make these representations to you are honest; and they believe what they tell you. But that which they tell you is not true. The stern logical facts and bitter experience which have buried electric light company after electric light company which has gone down in darkness and financial ruin, are the tombstones all along this road which show where the contents of men's pocket books have been scattered by the way. Where is the fault? If the fault is not with the men who have urged you to buy their wares, it must be in the patent office. These are the conclusions which laymen come to. These are not the conclusions of the lawyer; but they are the stern conclusions which those who have lost their money, sinking it in these speculations—that is the word—speculations, when they thought that they were engaging in a fixed and substantial business; it is the stern conclusion which these gentlemen come to who have invested and lost their money—that there is something wrong in the patent office. I am not speaking for men who possess a patent incubator, or for the man who has a patent plow, or a patent harrow, or a patent washing machine, or a patent cider press, because I permit to each of them the same liberty of speech and action which I ask for this association, and for its members individually; but I say that what we want to do is to protect our own interests as far as lies in our power; and we cannot protect them by sitting idly by and seeing this thing going on. We must act. I want to refer to the lawyers once more; but I do not want to do it unkindly or have them think that what I say is intented as a reflection upon them individually. If there were no sick men there would be no need of doctors. If there were no imperfect laws there would be no need of lawyers. [Applause.] And, just as far as you protect the work of the patent office, just so far as honest safeguards can be thrown around these papers which are reached with the broad seal of our country upon them as the signs of protection to men who have invested their time, their money and labor in bringing out some thing for the benefit of mankind, and incidentally for their own pockets as a matter of course, just so far as these things can be remedied, just so far is Othello's occupation gone; and the lawyers have nothing to do. [Laughter.] Perfect the patent laws and there will be no use for patent lawyers. I am talking outside of lawyers, and in the interest of this association and the members of this association. And I say that the paltry dole that you spend in aiding this legal committee, whether it be $250 or $5,000, would be money well spent if it only succeeded in bringing before congress a discussion of this thing, so as to lay bare the impositions which have been laid upon inventors and investors, and the frauds which have been perpetrated upon men who have invested their money in patents. [Applause.]

MR. LEGGETT: I do not see that the remarks of our worthy president alter the conditions of the facts at all. The suggestion was made by the gentleman upon my left that good laws will not stop litigation. Good laws are just as easily infringed as bad laws. The fact that a law is good does not stop the breaking of it by this or that individual. It can be broken just as much, whether it is a good or a bad law. It all comes back to the old proposition—what have we to do with it? Where are we materially injured in this matter? Not by the fact that the patent office, seeing that we have a good invention, gives us a patent for it; not by the fact that the Thomson-Houston company comes along awhile after and induces the patent office to give them a patent for an improvement on our invention. The suggestion was made by our worthy president because the patent office issued a patent it ought to stand still and never issue another patent which would infringe it. That, it strikes me, would be the very worse policy in the wide world. It would be suicidal. Where would it have left the sewing-machine? It would have left the sewing-machine with the Elias Howe invention—a needle, with the eye at the point, and with mechanism which could not drive it through a hundred stitches. What followed right after that? Another man came after who saw that the cause of the breaking of the thread was the fact that as the needle passed through the cloth, taking the thread with it, making a larger hole, and thus an abras on was thrown upon the thread and it broke. What was the next thing done? There came along a man who made a little groove above the eye of the needle, so that as the thread passed down through the cloth the thread lay in the groove. What would have been the result if the first patent had stood in the way of all improvements on the sewing machine?

THE PRESIDENT: Let me say a word. There was nothing in my remarks intended to prevent anybody from making improvements upon base patents.

MR. LEGGETT: I concede that; but is not that just exactly the situation which throws these competitors into our market? It is precisely that and nothing more. That man came out with a sewing machine having the eye in the point, but no groove. Another man makes a groove above the point and nothing more. But that was not enough to procure a perfect machine. It occurs to another man to make a groove right below the eye. He gets a patent for that. A needle having a groove above, and a groove below the eye, into which the thread is pressed, and so prevents its breaking when being driven through the cloth, is what made the machine a success, and makes the perfect sewing machine of the present day. Who is entitled to the credit of that invention? Not the first man entirely. The fact that every machine which the subsequent inventor makes infringes every patent which has gone ahead of him, makes no difference. It is for the law to get at that. The law is not defective which gives to the second and third man a patent. It is just so with our electric light plants. The Brush company came into the field first with patents which were practically the ground patents; and shortly afterwards came Weston, Thomson Houston, Farmer, and others. Each one of them had something which was regarded as an improvement by him a patentable improvement, over some things that had gone before. And the patent office gave each of them patents. That was all that the patent office could do. It is perfectly proper that it should do this, and not to give a patent which would cover all future inventions in the line. These patents came out; and they established electric light plants. Now, the law is brought into play to invoke protection of these ground patents. Now it is asked, what has the law done for us? Why has there never been a decision sustaining an electric light patent? Simply because, as I will venture to say, there never has been but one patent suit involving the electric light system which has been brought to a conclusion, and that is the one which I suppose is referred to. That was the clamp of the Brush electric lamp, which was defeated at Hartford, which will soon be heard on appeal in the supreme court. Why was it defeated? Not because the patent law was bad, but because the patent law was good. It was, to be sure, decided upon a point which had not been argued, and if argued, a result might have been different. If anticipated by another party it should be defeated; and that question is the very one to be determined by the supreme court. Our patent laws, as I have said before, are in

good shape. There are certain things which need modification and change—certain things which change would greatly improve doubtless; but it seems to be folly for us to divert the funds of this association in a channel which will take care of itself. There is no danger of this bill which my friend referred to—a bill giving to the user the right to use a thing if he is an innocent purchaser, being enacted; it is contrary to the constitution. The same matter has been before the senate of the United States time and time again. Unconstitutional measures are seldom passed by the senate of the United States. They stop before they reach that point. We have a right to expect that the law-makers of the nation will take care of those things when they come properly before them. All these little things such as this, frighten nobody, for they amount to nothing. Such a bill will probably never get through the committee even, because the committee generally has a good constitutional lawyer upon it. It is a bug-a boo. I simply reiterate the statement which I made before, that we ought not as an association to do more than express our opinion. When it comes to individual action then let each one act for himself and contribute as much as he sees fit.

MR. FOOTE: Your remarks, Mr. President, about the enactment of an ideal law, or a perfect law, calls to my mind the fact that some years ago a person who has been said to be pretty wise, wrote on a tablet of stone a perfect law; "Thou shalt not steal." Now, if that law had the power within itself to give the protection which you seem to think will come from a perfect law, there would be no need of lawyers in the country now. [Laughter.] I do not expect that we can get from a committee any greater wisdom than was supposed to belong to those who made that law; and therefore we need not expect any more perfect law than that. While I am in sympathy with the objects sought to be gained by this movement, I am also entirely in sympathy with Mr. Leggett in his objection to the method taken to gain that end. I think, as an electric light association, that we are putting ourselves before the public somewhat in the light of a family quarrel among electric light people on this patent issue. If the patent laws need mending, if there is any improvement to be had in that respect, we must remember that we are only a small portion of the public who are interested in patents and who will be interested in any movement having that object in view. I think that the question should be brought forward by the owners of patents, and not by the electric light interest only. There is somewhat of a tendency in the public mind even now to oppose monopolies in electric lighting, as in telephones; and if we take up the issue individually we are liable to enhance that feeling rather than to allay it. Therefore I think we ought simply to recommend that an association be formed representing all the owners of patents; and that this association, as an association, take no further action in the case.

MR. DUNCAN: The matter presents itself to my mind in this way: The action of this body so far has been simply this: They have organized a committee to take in hand the subject matter that has been under discussion this morning. They did not authorize that committee to spend a single cent of the funds of this association; but we did say to that committee, "We give you the moral support, the moral backing, of this association. We believe that it will be a good thing not only that this association shall be at your back, but we authorize your legal committee to go outside and to interest other parties in bearing the brunt of the financial fight which will have to be made." That is the action of this association up to the present time. Your committee has made its report. This committee states that they have not spent a single cent of the general funds of this association; but they have asked for voluntary contributions from parties who are interested in this matter, and that they have received meager responses to that appeal; that they have spent judiciously as well the amount of money that has been put at their disposal; and that they have in their treasury $250 to be used in further efforts. The simple question now presents itself to this association; will they still further support their committee in the efforts which they have made or will they lay the whole question upon the table as has been suggested? What would be the wisest course to take? If this association is convinced as a body that as individual members they have an interest in this matter, then they have a right to subscribe toward the purpose which that committee has in view; that there is no obligation upon this association to financially back up this committee; and that they simply use the legal committee of this association as an organized committee to obtain support outside, as well as their own individual efforts in that direction. Then what is the wisest method of procedure? Is it to stop right in the middle of the effort which is being made and compel the committee to say to the people whom they have attempted to interest in this matter, "We have gone so far and our association has no back bone; they do not believe in this thing; and they have laid this matter upon the table?" Or, will the association by a vote approve the course of its committee in the past, telling it to go on as individual members, and we will aid them or will the association simply lay the whole question on the table? That is the way the matter presents itself to my mind.

MR. LEGGETT: I offer the following:

Resolved. First, that the matter of patent legislation be discontinued so far as relates to any action of this association as a whole; and that it be confined to an expression of opinion. Secondly, that the association funds be not diverted to that end.

THE PRESIDENT: The resolution of Mr. Leggett is before you. What disposition will you make of it. It is in order to make a motion to adopt the resolution.

MR. FOOTE: I second that resolution.

MR. MOSES: I move, as an amendment, that the thanks of this association be tendered to the committee who have so disinterestedly expended their time, energy and influence in advancing, what they considered to be the interests of this association.

MR. LEGGETT I accept that amendment.

MR. DECAMP: I offer as a further amendment that the committee be compensated for any expense which they may have incurred, and which will stop after this resolution is adopted.

MR. LEGGETT: I accept that amendment.

THE PRESIDENT: The amendments of Mr. DeCamp and Dr. Moses are accepted. Are there any further amendments?

MR. DUNCAN: I move, as an amendment, that the whole question be brought to a direct issue; that the report of the committee be approved; that the legal committee be continued with the proviso "but without expense to the association."

THE PRESIDENT: I understand that to be offered in place of a substitute?

MR. DUNCAN: Yes; as a substitute for the original motion.

The motion of Mr. Duncan was agreed to.

DR. MOSES: We have the pleasure of having with us to-day a gentleman of distinction in electrical matters,—Prof. E. L. Nichols, the successor of Prof. Anthony at Cornell University. I hope that the privileges of the floor will be extended to him; and I would also suggest, since amendments are in order, and are flying thick in the air at the present moment, and move that we request him to allow his name to be added to the committee on insulation; in order that we may obtain the advantages of having such a laboratory as that of Cornell University at our disposal. I would also suggest that the name of E. G. Acheson,—a gentleman whose name has been brought prominently before the electric world recently as the inventor of a very beautiful heat transformer, transforming heat into electricity, be also added to that committee.

MR. DUNCAN: I would suggest that before that motion is put, as it might be construed as conflicting with the constitution, that the gentleman allow me to amend his original motion by moving that the two gentlemen whom he has named be made honorary members of this association and then they can be appointed upon the committee.

DR. MOSES: I think that Mr. Acheson is already a member.

MR. DUNCAN: Then I make that motion as to Mr. Nichols.

DR. MOSES: I second that motion.

THE PRESIDENT: The motion is to elect Prof. Nichols an honorary member of the association. The secretary states that Mr. Acheson is already a member.

Prof. Nichols was elected an honorary member of the aassociation and Prof. Nichols and Mr. Acheson were added to the committee on insulation.

THE PRESIDENT: Before reading the next paper, I would suggest that the recommendation of the committee as to an amendment to the constitution increasing the dues from $10 to $20 per annum be taken up, that was put second on the list of business this morning, but owing to the interesting discussion which has taken place, it was overlooked. Mr. Duncan will report to the action of the committee in respect to that committee.

MR. DUNCAN: Your committee offer a substitute for article 8 of the constitution. The present article reads as follows:—"The membership fee of each member shall be $10, which shall accompany the application. The annual dues shall be $10. payable in advance and shall cover the calendar year." Your committee are unanimous in recommending the striking out from that article of all requirements to an initiation fee; and making the article read as follows: "The annual dues shall be $20, payable in advance and shall cover the calendar year."

The amendment was adopted unanimously.

LEATHER BELTING—ITS ORIGIN AND PROGRESS.

BY CHAS. A. SCHIEREN.

In the early part of this century the first attempts were made by English machinists to transmit power by means of bands or straps made of leather; this transference of power from one line shaft to another, needed a peculiar quality of material, one that combined pliability, solidity and strength, and leather was the only known substance which suited that purpose. Many experiments have been made since then with other materials, such as rubber textiles, wood, paper, and even iron and brass; also belts woven of horse hair, etc., but none have been able to supersede leather, and even to this day it is universally acknowledged

"That there is nothing like leather
When well put together."

Belts made of leather are given the preference wherever they can be used, and it is somewhat strange that the machinery world of to day knows so little about the origin, progress and growth of an article that plays such an important part in the transmission of power, as leather belting.

For the benefit of those who have not read up the history of belting, I will give a brief account of the development of its manufacture in this country, and it then will be seen that this branch of trade has kept steady pace with this progressive age. Previous to 1820 and even up to 1835, much of our machinery, which then consisted principally of looms, etc., was imported from England and had all the necessary belting sent with it. These belts were made in a very crude way, generally from heavy leather and were cut across the hide, so that all the laps or joints were from the belly part of the hide. These parts were lapped over from six to eight inches and were not cemented, but were sewed together along the edges with white alum tanned leather, similar to lacing; then large heavy rivets were put in the center, and the whole thing made as clumsy and as heavy as possible.

In those days machinery was run at a very slow rate of speed, the belts had to bear a severe strain and therefore generally proved unsatisfactory; so much so, that machinists became discouraged and used gear wheels and upright shafts instead of belting. Upright shafting was largely used in flour and other mills where heavy work is required, as late as 1860.

Belt making up to 1840 was hardly known. Leather dealers and curriers, it is true, kept some extra dressed leather on hand for belting purposes, which mill owners and saddlers bought and made up into belting. All this stock was neither selected nor stretched, and the quality of belting it made can easily be imagined. In 1842 Wm. Kumble began the manufacture of leather belting at 33 Ferry street, New York. He also had a tannery in Frankfort street, where the bridge stores are now located. The foreman of this tannery, Fred. Wood, an ingenious and enterprising mechanic, invented some of the machinery necessary to stretch and join a belt in order to make it run smoothly, evenly and straight. Mr. Kumble gained quite a reputation at this, his new enterprise, and it was not long before he had several competitors. Thus belt making became a distinctive and separate business, and before long, through Yankee push and ingenuity, we manufactured a belt in this country which was far superior in quality and workmanship to any made in Europe. Since this we have not lost our advantage, but on the contrary have made such great strides in this line of business, that to-day it is universally acknowledged that the United States turns out the best belting in the world, and American belting is as much sought after in England and France as the "Peep o'Day" Yankee clocks are in England.

European belt makers are striving to imitate our methods of making belts, and for this purpose purchase our improved machinery, with which they hope to make a cheaper belt of equal quality, and thus drive out American competition.

However, I must return to my subject. My first illustration shows the method first employed for making a joint. This was of course found to be deficient, and soon an improvement was made, which consisted in chamfering the end of the under-lap, which came in contact with the pulley, so that the belt was much smoother and better.

Waxed thread was used to sew the belt and light rivets were used in the construction, which made it run easier, but as the leather was not stretched the belts would stretch all out of shape, and the pulleys had to be flanged in order to keep them on. Not until Mr. Wood conceived the idea of stretching leather before being cut into belting, was this trouble entirely obviated and a flange on the pulleys no longer needed. The inventions of Mr. Wood, however, are now superseded by more valuable improvements which supply the present demand for perfect running belts, and the belts of to-day are as much superior to the belts of Mr. Wood's time as is the steam engine of to-day to the steam engine of 1840. When Mr. Goodyear invented belts made of vulcanized rubber, everybody thought they would in time supplant leather. Rubber belting offered great advantages, being cheaper and made without joints, perfectly even and smooth, and apparently ran much easier. However, many disadvantages were detected by actual use, and very soon rubber belts took their particular place in the use of belting, and are now manufactured in very large quantities; but for all swift-running machinery leather is absolutely necessary and most reliable, and generally preferred.

During the war the demand for belting increased enormously, and it taxed the facilities of the belt makers to supply the demand. This made them somewhat careless, and the quality of belting greatly deteriorated. The aim of the belt makers seemed to be, how much of the hide could be put into belting irrespective of quality. At this time Mr. Underwood invented a method of making belts of pieces of leather six to seven feet long. He put short laps at both ends and covered the thin and flabby neck leather with splits which made them even with the butt ends. These belts proved to be a total failure and were soon abandoned. Mr. Underwood, however, made many other valuable inventions; his well-known copper shank rivets, and burs, placed on the ends of laps to prevent them from raising, are still used by some, and his patent angular belts created quite a sensation when first introduced. The latter was a novel and ingenious invention. Great power could be transmitted with narrow angular belts, but they have outlived their usefulness and are now supplanted by other later inventions.

In the midst of this great demand for cheap belting, Joseph B. Hoyt revolutionized the trade by going to the other extreme. He gave orders that all of his belts should be made with short laps only, that the butt end should be joined to the shoulder lap, to accomplish which the whole shoulder had to be cut away. He ordered also that only thirty-six inches of the center of the hide should be used and that every width of belt should be stretched by itself. This was a most radical change and startled the trade, while it gave Mr. Hoyt a world-wide reputation for belt making, which he held until his retirement from business with a large fortune, a few years ago. J. B. Hoyt deserves credit for having established a standard for belting which is reliable, and can not be surpassed, unless, indeeed, the nature of the steer hide changes. The trade everywhere has been compelled to adopt this method of making belts, because customers have been educated up to it, and many of them will buy nothing else.

About 1865, our manufacturing industries developed to an enormous extent, and immense factories were erected which required engines of great power, that could transmit from 500 to 1,000 horse power. This created a demand for very wide main driving belts, and great difficulty was experienced by belt manufacturers in making wide main driving belts over 36" which would be of uniform solidity and equal tension. Whole hides contain on an average thirty-six inches in width, of solid leather, and never exceed forty-five inches, while orders came in from all sides for main driving belts from fifty to seventy-five inches in width. Ever since this time experiments have been made on wide belting, and to day we have reached such a state of perfection that leather belts of any desirable width can be constructed.

A main driving belt is now generally made on the following plan. Take for instance a double belt six feet wide; The lower or running part of the belt consists of two pieces of leather of equal widths, cut from the center of the hide and joined parallel; then a thirty-six inch piece is placed in the center of the lower two belts, and two end pieces filled out to the required width, and all joined with parallel

joints. This makes a belt of uniformly solid leather, and equal tension, and one which is bound to run perfectly smooth and straight. Powerful stretchers have also been invented, which can take in any width of leather. Alexander Bros. patented a method by which they can use side leather and accomplish the same result However, they do not make a parallel joint, but simply butt the pieces, and then cement and rivet them.

Eastern belt makers were the first to produce a light double belt, with neither rivets nor other fastenings, claiming that rivets and burs were not necessary if a belt was properly cemented. They were used for machines running at a high rate of speed.

About 1864, B. N. Clark of Boston, Mass., made that line of belting a specialty. He produced a belt which would probably find great favor to-day for running dynamos. His method was to split the pieces of leather to a perfectly even thickness, and then cement them together. This made a double belt, rather thin, but well calculated for high speed. Mr. Clark retired from business about ten years ago.

Many experiments have been made to combine textile materials and leather in the manufacture of belting. In 1872, Clark & Slemmer, of Philadelphia, patented a belt of this kind. Their method was to stretch a heavy piece of cotton duck of the width required, and place it between two thin pieces of leather of the same width. This made a strong belt which at first was received favorably by the trade, but which in the end, did not wear well because there was two different kinds of material used; the cotton would stretch more than the leather, or *vice versa*, and the belt would very soon work itself loose, and the cement and rivets break. Very few of these belts are now in use at present. Another method is used which was patented by T. Thompson, of Cincinnati, and which is now manufactured by an Eastern concern. In this process, as in the other, a heavy cotton duck is stretched, a thin layer of leather splits cemented over its surface, and then the two sewed together. These belts are used to some extent on dynamos. Their main weakness, as already stated, is the unequal stretching qualities of the two materials used, but this objection is not so marked where thin pieces of split leather are used, as above described. The atmosphere, however, exerts a great influence over these belts, and they contract or expand with heat or cold, and can not therefore be recommended except for easily adjustable machinery. Numerous other patents have been devised but are of minor importance.

Edge-cut leather belts are hardly known here, but are largely used in England for running machines where slow, heavy and positive motion are requir d, and they do excellent work. These belts are made in the following manner: The leather is dressed and stretched the same as for ordinary belting; it is then cut into strips one inch wide and holes punched at distances of one inch from each other, to admit of steel bolts being inserted. These strips are then placed side by side, until the desired width is obtained, when they are bolted and riveted together. This makes a belt which is rather clumsy, heavy and stiff, but one that can stand more strain and hard work than any other belt made, and is very powerful.

This audience, however, is probably interested more in the progress and improvement made on leather belting for special use on dynamos and electric light machinery, than in the progress made in any other branch of the trade. I shall therefore describe different styles of leather belts which have met with great success in this field.

When the electric light first came into use electricians found it extremely difficult to get a belt suitable to use on dynamos. All of the belts which they tried seemed to lack something, and oftentimes the heaviest and most carefully made leather belts failed to do the required work. This problem received special attention by some of our most enterprising belt makers, and various methods for making these belts were introduced with more or less success. About five years ago the writer experimented on producing a belt which would be particularly fitted for transmitting power when run at a high rate of speed. I consider the stretching process of leather for dynamo belts the most important, because the steer hide by nature forms a peculiar shape, having fine and solid fibers on the back and then rounding off towards the belly with loose coarse fibers; to get therefore a perfectly flat piece of leather of even tension from the center of the hide it needs the utmost care.

The wide pieces of the center are generally put into the stretching strain, leaving the short piece free, and thereby stretching the whole piece on an equal strain; or, to explain it more fully, if you wish to stretch a 24" center piece of leather, you place your clamps eight inches on each side and leave the center eight inches clear; this will draw up enough under the strain of the side pieces to be perfectly even, or rather, the side pieces which contain more stretch, will draw its tension even with the center.

I also prepared a dressing or extra coating for the leather which made it very pliable and also very smooth by filling its pores. Another important improvement for dynamo belts, was making them light double and perfectly even in weight, so that every square inch of the whole belt was of even weight and tension throughout. This caused the belt to run without vibrating like ordinary belts, to run more steadily and give a uniformity of power so necessary for producing electric light. Nor did the belt contain copper rivets and burs or other obstructions, but simply small wire endless screws, and its tensile strength was greatly increased by fastening the edges of the belt with these wire screws which held the leather firmly together, and yet offered no obstruction to the smooth surface of the belt.

However, no belt has ever created such a sensation in the trade as link leather belting. This is a comparatively new article in this country, having been introduced two years ago. Since that time so many improvements have been made in this line of belting, that it can now be used on any kind of machinery. During the past two years these belts have done excellent work. They are made in the following manner: Small pieces of solid selected leather are dressed with tallow and neat's foot oil, which acts as a lubricator to the joints of the pins. The leather is then put through rollers and made very solid; it is then cut into small links; this process makes a link of remarkable tenacity and strength, and one which will bear more strain than a piece of hard rolled sole leather. The links are then carefully assorted as to thickness, and the belt built up to the required width. It is of great importance that each belt be made up of accurately assorted links, in order that an even width and perfect running belt may be secured.

A joint is of great improvement in this line of belting. Two bolts are used to each width of belt, and the two widths ingeniously joined together and forms an unbroken surface. This makes a belt which will conform itself to any pulley, whether flat, round or cone.

The belts should be run as loosely as possible, and should not be taken up unless they actually slip. An inexperienced person, upon seeing one of the link belts running on a dynamo would naturally think that the belt was loose and needed tightening, but these belts have such a remarkable grip power, that though when running the upper part of the belt is so loose that it almost describes a semi circle, the under side is as tight as possible. Leather link belts will in time find great favor with belt makers, as they are more pliable than any flat double belt can possibly be made, and for belts running at right angles, I claim that they are the only reliable belts for such a position, that will give satisfaction

THE PRESIDENT: The paper is now before you for discussion, are there any remarks?

MR. POPE: I would like to ask the gentleman with reference to the wearing of the edges.

MR. SCHIEREN: The first belt which I made up about six years ago is still running. Before I came to this convention I took it down and told my man to take it apart, to take about six inches of it in order to see the elongation. We have kept perfect time as to that belt. The belt is 33 feet 7 inches long, and it had stretched 9 inches in the first three months. After that there was no further stretching. We took the belt down, examined it closely, and found no elongation whatever. This belt is 3½ inches wide, one inch thick, and transmits fifteen horse power under the following circumstances: It has two 38-inch pulleys, and the pulleys run at the rate of 125 revolutions.

MR. POPE: I would like to ask what has been the experience in Europe during the length of time that these belts have been running there.

MR. SCHIEREN: My attention was drawn to these belts when I went to Europe twelve years ago. I looked into them at that time and thought very little about them. About six years ago I went to Europe again and looked at them, and thought better of them. I thought there was something in that belt that filled a gap in this country, and I determined there and then that I would try them here. However, other matters came up and I did not try them until three years after that. In reference to the experience in Europe I will state that, two years ago I was there and met several electricians, and got from them some very valuable information with regard to the use of link belting in running dynamos. Their dynamos there are run much slower than yours here. A great many of them favor these linked belts. They only use one pin there; and engineers told me that it takes four months before the pin adjusts itself to the rounding of the pulley. Although there are several patents there now, they make belts similar to those made in this country. On the whole, they speak of them very favorably.

MR. POPE: One other thing suggests itself, and that is as to the rapidity of the alternating system— running at 1,600 revolutions; whether in that place the link belt would be preferable or as good as others.

MR. SCHIEREN: Two months ago I received an order from a firm and a gentleman called on me and said: "Your link belting has attracted my attention, and I would like to receive some information about it." I explained to him all about the belt, took him into the factory, and explained the whole process. He said, "My company would like a belt which would run a mile and a half per minute; can you make it?" I said that I would try to do it. I did; and I was successful. The belt worked successfully. I made it out of very light material. The belt is to-day running at the rate of a mile and a half per minute. I suppose that that is the kind of belt that Mr. Pope has reference to.

MR. RIDLON: I have used one of these belts, three and a half feet wide at a speed of 2,000 feet per minute. The only fault I can find with it is the stretching. We took it out two months ago and there has been no trouble since.

MR. RICE: I would like to ask Mr. Schieren in reference to the amount of power consumed by this belt as compared with ordinary belting. Does the belt itself use more or less power—I mean, for the bending of the belt over the pulley?

MR. SCHIEREN: I am sorry to state that I am not a civil engineer or a mechanic; I am a belt maker. If you come to me and say you would like thus and so done, I am ready to go into it and to give it my attention; but if you ask me certain questions,—as, can that belt do thus and so at a certain speed I cannot answer. My experience in link belting has been that it will transmit under certain circumstances more power than the ordinary belt. It will do it every time. In some instances we have put on an eight-inch belt and have taken off a twelve-inch belt. In some instances we have put on a twelve-inch link belt and have taken off a ten-inch belt; and it would not drive with a ten-inch belt, owing to the difference in circumstances. So to-day I may say that we are ignorant in regard to the amount of power comparatively that they will drive. We are constantly making experiments and improvements, and are gathering valuable information in that way; but I am sorry to say that I cannot answer your question intelligently.

MR. LAW: I would like to ask Mr. Schieren if he has had any experience, or enough experience to determine the amount of damage that oil does to this belt, as compared with ordinary double belting. In some classes of our dynamos a large amount of oil is soaked into the belt, and I would like to know if that has any effect upon this linked belt.

MR. SCHIEREN: So far, no claim has been made in that direction. Of course you will understand that if the leather lies on the edge it exposes the fiber of the leather more than if it lies on the smooth surface of the leather. Leather is a great absorber. I use blotters of leather in my office; because leather absorbs a fluid at once. No doubt you have noticed this in running your dynamos. It absorbs oil very fast. To my mind, to answer your question, I think that the link belt would absorb oil more than the other belts, although I have had no experience. It is necessary that the link belt be exposed on the edge, and therefore it would absorb quicker than the other way. But that could be obviated by using a dressing which would close the pores of the exposed part of the belt.

MR. DECAMP: Is not one of the great advantages attending the use of the link belt the fact that it can be run slack? That being the case, is its use confined to horizontal belts? In that case it would be necessary to have the slack side on top, it is not possible.

MR. SCHIEREN: That is true. The link belt will only run successfully if the slack side is on top. If the slack side is below the best will very soon flop on your floor, and your power is gone. They do not run successfully in that way.

MR. LAW: What sort of success have you had with almost perfectly perpendicular belts?

MR. SCHIEREN: We have had very good success. The only trouble with perpendicular belts is this: At first these link belts stretch considerably. I have learned a great deal since I undertook to make belting. I have alluded to these edge-cut belts, which are enormously strong. The Englishmen recommend and use them for their slow, heavy power. I have seen in England, six-inch belting transmit power that I know my 24 inch belting would hardly dare tackle. It was edge cut belting, an inch and a half thick, and bolted together. If you take a piece of leather that is three feet wide and one inch thick and stretch it in a stretching machine, you will stretch probably 10 per cent. of that belt unde certain circumstances. If you cut up that piece of leather into small pieces of two inches and bolt them together you cannot stretch it a foot. Why is this? It is because the little pieces seem to have more elasticity than the longer pieces have, or more than when they were combined together. There lies the great trouble in these linked belts. I have studied the question very deeply; and to overcome that I have made a certain method of preparing the fulling—these small pieces—with a dressing that tends to toughen them, and tends to harden them at the same time, so that they will not stretch as much as the whole piece of leather would. The belts that we make to-day are full of that material—all that they will possibly take—and the leather is even tougher that steel; it will cut steel.

F. C. SMITH: I can say, in answer to Mr. Rice's inquiry as to the bending strain of belts, that, without having made any particular examination of it, any one who has looked at an ordinary belt running at a high rate of speed will notice that the speed of the belt is not sufficient to overcome its stiffness and make it lie right on the pulley; but a linked belt will in all cases lie right on the pulley, and form a true tangent to the edge of the pulley wherever it strikes it. The flexibility of the belt is so much greater than that of an ordinary belt that the bending strain is less. With regard to vertical belts I will say that we had a belt of that kind, running 7,500 feet per minute, and we found that a link belt, while running at that tremendous velocity, would carry more power and stick closer to the driving pulley. They seem to have a peculiar way of sticking to the pulley very closely. I have had very little experience with belting; but we used one of the eight-inch belts, and then we tried a link belt, and it did the work first-rate; but we had to abandon it for a very curious reason, and that was that when running the link belt at such a high rate of speed it caused the belt, in coming down on the pulley, to make such a terrific roar that it made the engineer sick; it gave him a nervous headache. It was due perhaps to the fact that our station was only six feet from the floor to the roof, and with the 300 horse power dynamo in a room only 20x30, it made a terrible noise. But, so far as the belt itself was concerned, its work was satisfactory. With the other belt we got rid of that trouble entirely. There are a great many things that come in in the practical work which we cannot see when a thing is designed, and it is not always what seems to be the best thing to put in that you can keep there.

The association here took a recess until 3 o'clock P. M.

Afternoon Session.

President Morrison called the meeting to order at 3 P. M. and announced that the first paper of the afternoon would be that of Dr. Liebig on motors.

Vice-President Weeks took the chair.

MR. RIDLON: I want to offer the following resolution: *Resolved* that article IV of the constitution be hereby amended to read as follows: The president and vice-president shall be elected by ballot to serve during the following meeting. The treasurer and the secretary who may be one and the same person, shall be nominated by the president, subject to the approval of the executive committee. The executive committee shall be chosen by ballot at each meeting, either annual, semi-annual or special, to hold office from the close of the meeting at which they are elected until the end of the meeting at which their successors are chosen.

MR. MORRISON: I move that that be laid over until to-morrow morning and taken up as the special order of the day to-morrow morning.

The motion was carried.

Dr. Liebig then presented an able paper on electric motors and dealt largely with mathematical formulæ entering into their theoretical construction.

MR. HARDING of New York: In regard to certain

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National Electric Light Association.

The convention of the National Electric Light Association at Pittsburgh this week was marked, as predicted, by a large attendance and as will be seen by the full report which occupies our columns this week, much valuable information was elicited from the papers and discussions. In the space at command extended comment is out of the question.

The list of officers shows not a new name to the electrical fraternity, but a new name attached to the title of president. The able presiding officer of preceding conventions refused re-nomination to that place, and now the name of S. A. Duncan takes the place of that of J. Frank Morrison. The latter is worthy of the encomiums so liberally bestowed upon him and if his retirement from the presidency included his retirement from the councils of the executive officers there might indeed be great cause for regret. However, his name appears in the list of the executive committee, and the association will not lose the benefit of his experience and ability. Mr. Duncan's name as stated in the opening sentence of the paragraph, is not new to the members of the association. He has been prominently identified with the association for some time and has won the honor conferred upon him. We can prophesy that the association will lose nothing by selecting Mr. Duncan for a presiding officer.

New York succeeded in securing the next convention. Cincinnati made a strong plea, but the eastern delegation was too strong.

Continued from page 93.

practical points, we all want to know how much money we can make by selling electric power. Now possibly a few figures which are the reports from about 80 stations which are now selling the electric current for power may be of interest. It is impossible to fix a price for any motor of any given size. That is to say you cannot take a five horse power motor and charge $500 a year. That you will see a little later is not possible. All of you in trying to sell electric power have met that difficulty. The first thing to do is to divide all the classes of industries you intend to supply, say into two or three classes: First, constant use. If you are running a ventilating plant and charge about $120 for one horse power, that is constant use. You take next such things as printing offices and machine shops—all work of that kind, which we call partially intermittent. In that case the price has been established—and it would be well, I think, to have a price throughout the country in order to settle difficulties as to what the price of power should be, because the company seems to think that the one who is selling the motor wishes to have a very low price, and the one who is selling the motor thinks the company wants more than it is worth. First, be sure to sell the machine to the customer. Where motors have been rented the result has not been satisfactory. It has been tried by gas companies. Steam companies have tried renting steam engines, but the engines are never cared for and are in wretched condition, and the same will be true of electric motor, and the repairs of the machines, after they have been run for a long time—not oiled and neglected, will more than eat up the profits. Take a half horse power motors; the average price seems to be $75 a year. Of course that is ten hours' service. That would be equivalent to about two cents a day, which for sewing machines is not high. One horse, $120; two horse $200; three horse $270; five horse $425; seven and a half horse power $600; ten horse power $750 and fifteen horse power and up about $70 per horse power per year. If you sell 15 horse power at $70 a year, the intermittent use will show a large profit. These data we have obtained in this way: On every machine running on the constant potential circuit of the Edison company in New York—also in other places—they put a motor and they examine the motor at the end of each month, and the data have been of great value, because we know exactly how much the customer is using. Take the third class, which is the elevator work; you will find that to be a very profitable source of income. In elevator work for a five horse power motor you charge $300 a year; for a seven and a half horse power motor $360. You can charge say about $400 for a ten horse power. Suppose a man puts in a motor of five horse power for a small freight elevator—if, however, he has a very large platform he can use a ten horse power once to take up a load—you will find he is not using so much current, Now from actual tests they have found in New York that on a freight elevator charging at lamp rates which is 1 1-5 cents for six candle power per hour, that is equivalent to $312 per horse power per year. The actual amount used very seldom exceeds $150 a year, which shows a very handsome profit indeed. If you calculate that you are selling your power at the same rates as you are selling the lights, then if you can make 10 per cent by selling your current for four hours per day, if you can sell current for ten hours a day you are making two and a half times as much, or 25 per cent possibly. These figures may help some of you in establishing the rates which you shall charge for power. [Applause.]

Independent Engines in Incandescent Stations.

Commercial success in incandescent lighting depends primarily on the continuous, cheap, uniform, and flexible generation of power.

BY W. LEE CHURCH.

The service of electric lighting differs from other forms of manufacture in requiring more horse power per square foot of floor space; in requiring higher speeds; in demanding the power in larger units; in compelling a closer and more uniform regulation; and in requiring more rapid and constant extensions. It will be observed that these peculiarities require individual and special treatment in the generation and distribution of power, and engineering practice as determined in other means of manufacture may be sadly at fault when applied to electric machines.

It has become an axiom among experienced station managers that the money is made or lost between the shovel and the belt. In other words, other things being equal the dividend-earning capacity of a station is determined by its steam plant, to which the electric apparatus is in the nature of an accessory. Incandescent lighting has not until recently made a brilliant record as an investment, and much of the disappointment is directly traceable to the culpable ignorance of the principles of steam engineering which has been displayed. A man who will not venture to cut himself a two dollar vest will not hesitate to exercise his amateur talent on a steam plant, upon the economical and reliable performance of which depends an investment of one hundred thousand dollars and the public service of a city. A long and critical experience in this branch of industry has grounded us in the conviction that no incandescent station can hope to be financially successful under the ordinary conditions of competition, unless based on independent dynamos belted directly from independent engines. Throughout this paper, therefore, we desire to keep constantly in view the opposite systems, namely, a station containing a given number of dynamos of two or three different capacities each belted directed from high speed engines of corresponding rating, and, on the other hand, the same station with the dynamos driven from one or two slow speed engines transmitting their power through a line of shafting and pulleys.

Having these pictures well in mind, we inquire: What are the essential requirements of a first-class steam plant in an incandescent electric light station? Taking them up in the order of their importance, we unhesitatingly say first, and always foremost: Absolute reliability for continuous running. The electric light company contracts to supply the demands of a diverse and exacting public, and that public expects to find its light on tap at every moment of every day of the year. Failure of service in ever so small a degree is palliated by no excuse. Complete reliability is the condition of popularity, confidence, and patronage, without which all the other economies and excellencies go for nothing.

Again, electric lighting perhaps more than any other industry has its earnings directly affected by the shutting down of its power, since it sustains a direct financial loss for lights out, aside from loss of custom and reputation, which are not easily regained. Subdivided power reduces this risk to a minimum, and properly directed and applied obviates it altogether. In a station using, 2,000 horse power, say, in the shape of two large engines, loss in income in one night by the shutting down of one of these engines is equal to one half the cost of an independent engine on the subdivided plan. In other words, as tersely expressed by a manager of experience, a company might better for peace of mind, reputation and cash balance on the books, throw a 60 horse power engine into the scrap pile than to shut down the station one hour. The service of electric lighting is similar to the editing of a daily paper in that lost time can never be regained. Most industries can make up lost time by working overtime and by pushing their business in various ways, but in electric lighting "the mill will never grind with the water that has passed."

Passing from argument to instance, we cite the recent experience of one of the largest stations in the country, operating in the neighborhood of 20,000 lights. This station as originally planned was driven from a pair of Corliss engines, each having a cylinder 28 in. in diameter by 48 in. stroke, and belting to a countershaft 4½ in. in diameter by about 50 in. in length. From this countershaft are driven five dynamos, having an aggregate capacity of six thousand 16 candle power lamps. Clutch pulleys 8 in. in diameter are employed, which are the means of disconnecting the dynamos, when not in service, with similar clutch pulleys for the exciters. The remaining dynamos in the station are each of 2,500 lights capacity, and each is driven by a 200 horse power independent engine, belted direct. Recently in the middle of the heavy run of the evening, an accident occurred necessitating the immediate shutting down of the six thousand lights, besides doing considerable damage, and involving danger to the employes. The extinguishing of such a large number of lights at the important hour of the run was a blow at electric lighting of the severest nature, and working serious inconvenience to public gatherings. It happened that one of the independent engines with its dynamo was immediately available, and was started within two or three minutes, so as to take up a portion of the load of the large engine. In this same station, at a subsequent time, a key became loose on the valve gear of the engine, necessitating another stop for several minutes. On still a third occasion the crank pin became uncomfortably hot, and was carried through the run only at great risk and labor.

This illustration is used as one among many of the almost evident facts that no electric light station can afford to hang its whole business upon any one source of motive power, particularly when the motive power is distributed through the complex mechanism of countershaftings, etc., involving risk of hot bearings, broken pulleys, defective frictions, and what not, any one of the which may shut down the whole station. Had these same dynamos been each belted direct from an independent engine the accidents mentioned could not have occurred in the nature of the case. We do not assume to say that accidents of some nature are not liable to occur in any piece of mechanism, but the division of power and generating capacity into comparatively small units, each independent of all the others, affords a practical means of distributing the danger, so that it is essentially *nil* in its effects, that is to say, had a stoppage of any one independent engine in a similar instance occurred from any cause, the other engines with their dynamos would easily have distributed the load for a short time without any disturbance or danger whatever, and the service would have been uninterrupted while the repairs were being made or the difficulties remedied.

It has been incidentally remarked by a gentleman familiar with the practical operation of a station, that independent engines afford a safeguard against danger from short circuits, inasmuch as the currents due to the short circuit will overload an independent engine and slow it down, thus giving warning of the danger. If the dynamo is driven from a single large engine the motive power will not respond to the short circuit until the short circuit becomes equal to the full capacity of all the connected dynamos plus the range of power in the engine. Practically, therefore, an engine of this type will not feel the short circuit, but will pull it through until something burns away.

That merit of the steam plant which is most obvious and which appeals most strongly to the electric light company is economy of fuel. The advocates of large slow speed engines rely upon the supposed superior fuel economy of this type as the sole offset to its obvious disadvantages. All managers unhesitatingly admit the superiority of transmitting the power directly and without loss from the engines to the dynamos, and more or less readily concede that in its performance the high speed engine will equal the running qualities and durability of the slow speed engine. If with this, say they, we could get the steam efficiency of the Corliss engine, no man would hesitate to decide in favor of the convenient, compact and independent small engine. We take the question at once by the beard and desire to state that of two incandescent stations operating under ordinary circumstances, and otherwise equal, except only in their power and transmission, that one which has independent direct belted engines will show on its monthly report sheet, not a small amount, but from one quarter to one-third less coal per lamp hour than the station driven from a single thr ugh countershafting, both types of engines being non-condensing. We go yet further and state that independent non-condensing engines under certain conditions will about equal in monthly coal account an equivalent slow speed engine. This is a fact so incontrovertible when actually and candidly investigated that we do not propose to demonstrate, but merely to illustrate it.

We now submit to the immediate inquiry: "Will not a high speed engine use more coal per horse power hour than a Corliss engine?" "Yes." "How much more?" Load for load not over 10% to 12½%. Score 10% against the high speed engine, and again ask: "Will not several small engines use more steam than one equivalent large engine of the same type?" "Yes." "How much more?" Load for load possibly another 10%. Score 20% against the high speed engines, and again ask how an admitted loss of one pound of coal in every five can be reconciled with the statement of a monthly saving of 25 to 30% in favor of the independent engines. Answer: Simply because we have to deal with conditions as they exist in fact, and not as we assume them to exist.

The reason why independent engines can overcome their moderate lack of initial economy, and pass a large percentage of actual economy to their credit, are mainly two: First, the use of a countershaft implies power to run it. Indicator diagrams show that the dead load of such a plant varies from 12 to 20% of the gross horse power under full load when in ordinarily good condition, and not infrequently rises to 30% and over, with badly lined shaftings

and badly drawing belts. Moreover, it must be borne in mind that the dead load is nearly a constant quantity, and if it amounts to 20% of the full load, it will under a partial load equal and even exceed the net power transmitted to the dynamo. It may easily happen, and doubtless does happen, every night in every station thus far, that from midnight to morning two or three horse power is expended in the cylinder for each effective horse power recovered at the dynamo pulley. Thus at one stroke and by a single item are the conceded advantages of the larger engine reckoned in the coal per horse power practically swept away, and large and small engines left standing on an equal footing, prepared to submit to the still more searching question: "What is the cost from hour to hour of the power actually expended in meeting the fluctuations of the load?"

To consider for a moment some abstract facts in steam engineering, we must note that the steam engine develops its maximum economy (i. e. minimum consumption) only over a limited range of its power. Under normal conditions of pressure, say 80 to 100 pounds in the boiler, this minimum consumption is found only between the points of 1-5 and ¼ cut-off, at which latter point all engines are now rated. At its rated power, therefore the single large engine of the Corliss type will consume as little as 26 to 28 pounds of water (steam) actually fed to the boilers per indicated horse power per hour. If overloaded, however, the rate of water consumption rises as shown on the right hand portion of the diagram [referring to diagram], in which the horizontal distances represent the actual points of water consumption; the curve, therefore, being a curve of efficiency at varying loads. It will now be particularly noted that, whereas the load rises for an overload, it also rises for an underload, and very much more rapidly. This is well understood to be partly from excessive condensation, due to over-expansion, and partly from the greater percentage of leakage under short cut-off. It will be seen that the engine can be at its best only over a limited range, say from 325 to 450 horse power. An overload is, of course, mechanically injurious, which limits the possibilities in that direction. As the load falls off below 1-5 cut-off, the steam rate increases in an enormous ratio, so that at 200 horse power the engine is using 50% more than its normal rate: i. e., at 200 horse power it is actually using the gross amount of steam which would give 300 horse power if used in a 300 horse power engine. At 100 horse power the waste is fully 100%, and the steam used should develop, not 100 horse power, but 200 horse power if used in a 200 horse power engine.

It now remains to determine if the conditions actually obtaining in electric lighting stations are such as will enable a single large engine to develop its normal economy, and if not, then are they such as will enable the smaller independent engine, with a less initial economy, to reach a better gross result under the inevitable conditions as they are found to exist? The typical daily chart of amperes delivered from an incandescent station, of say 4,500 lights, is shown in figure 2 [referred to diagram], of course with variations in different stations, but always of the same general character. The chart is assumed to cover a winter night's run, commencing at 4 p. m., and shutting down at 8 a. m. The heavy irregular line A B represents the fluctuations of the actual load, such as would be determined by indicating a series of independent engines, and the area inclosed between it and the base line. M N may be denominated the net power required. The irregular line C D inclosses the gross load when driven by a single large engine, being equivalent to the net load plus the friction of the shafting and pulleys required in transmission. The irregular band lying between A B and C D, therefore, represents the dead load, which would be a dead loss, due to the friction of shafting. But, as shown above, this is not the full measure of the loss. We have already seen in figure 1, that an excessive underload requires a relative amount of steam which would be adequate to produce a much greater power if applied in an engine worked at its point of maximum efficiency. Combining the two diagrams, therefore, we would find a third dotted line E F, which would clearly represent the actual steam consumption required to secure the net work A B. The irregular band, therefore, between A B and E F represents the total loss expressed in coal. In other words, the entire area E F M N represents the lamps which should be got for the steam expanded, whereas, A B M N represents the lamps actually got for the steam expended. The loss involved is practically 50% of the total fuel in the whole night's run, which corresponds to observed results in stations whose fluctuations of load are about as indicated. Of course there are stations in which the net load averages more uniform than that shown, and a better proportionate result would, therefore, be expected from the single large engine with countershafting. We believe it safe to say, however, that there is no incandescent station which will get a load so constant as to secure the economy from a single engine equal to that which can be realized from subdivided power. We now contrast the performance of independent engines in the same station. The lower narrow band between the lines MN and *aa* represents the smallest dynamo, equal to a load of 650 lights. The remaining three bands between *aa*, *bb*, and *cc*, represents the other dynamos, or successive loads of 1,300 lights each. At starting time, therefore, a 60 horse power engine with its 650 light dynamo is started, and run continuously until shutting down in the morning. It will be noted that while running, the load on this engine is practically constant and at the point of maximum efficiency. In ten minutes after starting, the load on this rapidly increasing, it becomes necessary to start the second 125 horse power engine with its 1,300 light dynamo, which engine, again, runs on its full and most efficient load, as indicated between the lines *aa*, *bb*. This engine is stopped at 12:45, and is, therefore, running to a disadvantage only for the last hour. At 4:40 the increase of lights calls for the third engine with its dynamo, which in turn runs until 10:45, and is then stopped. The fourth engine and dynamo will start at 5 p. m., and run until 9:30 a. m. The point to be clearly understood as vital to the whole economic question, is, that each engine while running is loaded to its best efficiency, that it runs only so long as its load is called for, then stops altogether, and with it all consumption of steam, leakage, radiation, wear and tear, and loss of every nature. Ample time is given to inspect the engine and the dynamo, if necessary and the system as a whole develops the last possibilities of commercial efficiency. The diagram practically represents the performance of two stations which we once had the privilege of comparing, both were of practically the same size, and both were constructed on the same electrical basis. We were by courtesy put in possession of the monthly reports from both these stations, which showed a ratio between the pounds of coal per ampere hour of 70 to 126 in favor of the station driven by independent engines. A station whose motive power is one or two large engines therefore, finds itself in a position of earning money between starting time and 10 o'clock and spending it again between 10 o'clock and morning. We have thus endeavored to make it clear in the above illustration that the rated economy of the two types of engines is but a small part of the consideration, and cuts practically no figure whatever in actual practice under the considerations imposed by the nature of incandescent service.

If any one is now unthinking enough to inquire: Why not use a number of small Corliss engines in place of high speed engines if it is admitted that the Corliss type is the more economical of the two, we would answer, briefly, first, small Corliss engines are not as economical as small single valve engines, the percentage of leakage due to the four valves and slower speed being much greater; second, small engines of the Corliss type run necessarily at so slow a speed as to preclude the possibility of direct belting, and to involve full lines of countershafting, with their attendant cost and waste of power; third, the first cost of small, slow speed engines is very greatly in excess of that of high speed engines for the same power. We think no one has ever seriously considered, however, the adoption of small independent slow speed engines.

Next in importance to reliability and economy is uniformity, delicacy and continuity of regulation. There is much misapprehension regarding the matter of regulation in engines used for electric lighting. Let us, therefore, ask: What is good regulation? Good regulation implies, as a matter of course, reasonably small variation in speed, reckoned in r. p. m, between the engine fully loaded and the engine running light. Claims are made that such and such engines regulate to 2 per cent., 1 per cent. and even ½ of 1 per cent., under variations of load. Now, it should be clearly understood once for all that any decent automatic engine controlled by a shaft governor can be so adjusted as to regulate, not merely to 2 per cent., or 1 per cent., but to actually pass the point of exact regulation and run faster under load than when light. So far as regulation in terms of r. p. m. is concerned, 1 per cent. or 2 per cent. regulation is sufficiently close for all ordinary purposes.

Secondly, the most important consideration in the regulation of engines in incandescent stations is not their variations from minute to minute, but from stroke to stroke. An engine may make 300 turns per minute, counted for each successive minute of the hour, and yet may at any given instant be running sensibly above or below this speed, in an effort to meet a momentary fluctuation of load. We say that every engine may do this, and we have observed that most engines do do this frequently, the difficulty being, not a matter of the construction of the governor, but purely a question of lubrication. A perfect governor is one which will maintain the speed, not at an average of 300 r. p. m., but at the rate of 300 r. p. m. for each and every stroke. A properly constructed governor will maintain the average of regulation to which it is set, but it can only secure instantaneous regulation when friction is practically eliminated. It has been our experience that nothing but a complete bathing of the governor in oil will practically accomplish this purpose.

Incandescent lamps require a regulation more delicate, perhaps, than any industry Any departure in regulation of stroke gives a variation of electromotive force which is speedily destructive to the life of the lamp, the item which, next to fuel economy, is the heaviest taxation. The injury is done during the period of acceleration immediately following the change of load, which period is the time between the change of load and the movement of the governor, and this in turn is proportional to the friction. It is obvious that if friction were annihilated the acceleration would be also *nil*, and the speed and consequently the electromotive force, would never vary.

Thirdly, under the extremely long runs now imposed by electric lighting service, continuity of good regulation is essential. That is to say, a governor which will regulate when well oiled will fail to regulate when its pin and bearings, being inaccessible under motion, have become dry during a long run.

As to the nicety of regulation obtainable from a slow speed engine, there is no comparison possible. We have already shown that it is not permissible for an electric light engine to vary its speed even from stroke to stroke. All observers know that it is frequently quite possible to count the revolutions of a slow speed engine, particularly when heavily loaded, by the pulsations in the lamps at a distance from the station. A slow speed engine, unless excessive in its fly wheel capacity, will imperceptibly slacken in passing its centers, and this variation, not visible on the engine, becomes a sensible and dangerous variation when multiplied to the speed of the dynamo. The fluctation of the needle of two voltmeters respectively registering from a high speed and slow speed engine will give abundant evidence on this point.

The characteristic of flexibility in electric light stations is one which is frequently overlooked until experience demonstrates its desirability. To secure the best possibilities in this direction it is necessary to use dynamos of two or three different sizes, say, of 650, 1,300, and 2,500 lights capacity, each being driven direct from its independent engine. The plant being thus divided into independent units of different sizes any variation of demand, either in the total load, or in the load required for different circuits, can be conveniently met. Owing to local causes the load of a station is not necessarily the same from day to day. It is obvious that a plant in which all the dynamos are hung upon one, or, at most, two, engines, is essentially rigid in its control of circumstances, whereas a station planned as indicated is to the last degree flexible in meeting any variations of load to whatever degree it may occur. All this has a direct bearing both on economy of fuel and incidentals of operation.

We would not wish to imply that the smallest unit in every station should necessarily be the smallest unit determined by the minimum load existing for any considerable time during the day. This minimum load in the majority of medium sized stations will represent about 1-8 to 1-6 the generating capacity. Beyond this it is, perhaps, advisable that the units be uniform for the sake of interchangeability of parts. The whole question of units of generation must be considered, not in the light of any one rule, but under all the circumstances of each particular case.

The maintenance account of a plant often defeats dividends. In the use of countershafting an entirely new factor of expense is introduced, pertaining to the shafting, bearings, pulleys, clutch pulleys, belts, etc. Each bearing of the counter-shafting will consume oil to the value of at least $5 per annum, and any considerable amount of shafting involves the pay of an extra oiler to properly care for it. Regarding the two types of engines under discussion, it is undoubtedly true that the maintenance of the high speed engine will be fully as low as of an equal horse power in slow speeds, as to its direct expense without taking into account the time lost in repairs. Nearly all high speed engines are made to gauge with more or less reference to the interchangeability of parts. Repairs in consequence are furnished at a minimum of cost, and the parts being light and readily handled, the engine can be stripped and overhauled, and connected, without the employment of an extra force of men or the necessity for heavy handling. In referring to high speed engines we, of course, only speak of those which are carefully and understandingly designed for the work put upon them. That is, we wish to draw a sharp distinction between high speed engines and engines speeded high.

The one danger to high speed engines arises from the possibility of charging the cylinder with water which can not be quickly enough relieved through a valve at the speed at which the piston travels. The fact that no engineer justly entitled to the name should ever allow an accident of this nature to happen, does not in the public mind shift the responsibility from the maker of the engine. Spring relief valves have now been brought to a state of perfection which leaves little to be desired, when the engine is of a type permitting their use.

The space occupied is one of the minor considerations which in certain locations becomes of considerable importance. Not infrequently electric light stations are located near the business portion of the city, where real estate is valuable, and taxes correspondingly high, and space counts heavily in the capitalized investment. Again, a large building obviously increases the investment, particularly when we know that a building to carry heavy lines of shafting at high speed must be of unusually massive construction. It needs no illustration to show that independent engines by doing away with the space occupied by countershafting and belts, under the least distance between centers which can be justified, require materially less space per horse power than any other form of non-subdivided power. This is particularly the case where the dynamos are placed on the second floor, over the engine room. Moreover, the cramped space in which the single engine must develop and distribute its power is against its satisfactory performance. The fact is generally overlooked in drawing comparisons that a single large engine in an ordinary manufacturing establishment, such as a cotton mill, has in the nature of the case, a wide space in which to transmit its power from the slow motion of the engine up to the high speed of the spindles. This means that ample space is given to bring the speed by gradual accelerations, through easy moving shafting of substantial nature, up to a moderately high intermediate speed, and then distribute it to the spindles in small quantities by means of simple and light fast running devices. In the dynamo room, on the contrary, the space is cramped to the last degree, and the slow running engine must in a short range multiply its power to high velocities, and transmit its speed in large units to the dynamos. The whole system of transmission becomes rigid and ineffective, and the loss consequent upon the friction, and risk to employes, and the magnitude of disaster when any occurs, are such as in themselves to overbalance all the economy which the most enthusiastic advocates of slow speed engines attribute to them.

An electric light station, unlike most other industries, is usually of very rapid and persistent growth, to an extent which is not generally foreseen in the original calculations. The use of independent engines lends itself readily to indefinite extension. The power and dynamos both being divided into like units, each independent of the others, extension becomes merely a question of more units, without any special preparation in the plan. On the other hand, the slow speed engine with counter-shafting is necessarily in large units, and to that extent fails to meet the requirements of a gradual increase. The use of the large engine involves an outlay disproportionate to the immediate returns from the first increase ordinarily provided for, and it necessitates also the operation of the moderately increased plant at a great disadvantage on account of the underload involved, as already explained. The practical operator will readily see the force of this important advantage on the side of the independent engine.

The first cost of plant, although really of the least importance among those enumerated, is distinctly on the side of subdivided power. The price of high speed engines per horse power is now fully as low, and generally lower, than that of slow speed engines. Cost of foundations is materially less, as is also cost of erection and handling for repairs. There then comes into the question the clear saving of all money invested in counter-shafting, pulley blocks, heavy

belting, clutch pulleys and similar devices. In the station to which we referred above the extra transmitting devices necessitated the investment of a sum of not less than $0,500. The price thus expended would be sufficient to purchase practically 500 horse power of independent engines, adequate to supply 6,000 lamps, showing a practical net earning capacity of at least $18,000 per annum. When we contrast this with the net losses due to the system of concentrated power, as discussed, it leaves no room for argument as to the advantages of independent engines in electric light work.

Economic Value of Steam Pressure Records.

BY JARVIS B. EDSON, M. E.

The engineer of the present century begins his operations based upon the pressure of the steam he is capable of maintaining in his steam boiler. From this starting point he extends his calculations and elaborates his plans for the prosecution of his work. It matters not what the problem may be, whether it is grain to be threshed, grist to be ground, hills leveled, mountains pierced, ore raised or office reached, ocean plowed or continent crossed, the same agent performs the work. The tropical fruit, while rushed to a northern market, is also cooled by it, and the plethoric meat of the western plain is refrigerated during its transcontinental run. At present the civilized world is lighted by it, and is searching for one greater than Faraday who shall give us a substitute and sound the death knell of steam. Meanwhile, we reconcile ourselves to the loss which passes up the chimney and stand aghast, when the boiler "lets go," scattering death and destruction in its path, and simply conclude with the verdict of "nobody to blame."

Investigation and scientific study have done much, however, both for the construction and the safe and economical management of steam boilers. Mystery no longer accounts for boiler explosions, for the conclusion has been reached that "the cause of such accidents can be wholly prevented and controlled," and ignorance is becoming dethroned in her management to make way for intelligent methods of boiler management. Men from our colleges and technical schools demand facts that they may proceed to their conclusions intelligently—not theirs, to view the 135 victims of the Westfield explosion with "nobody to blame," for it is not they who beat upon pans and blow horns to scare the "devil" when the sun darkens. The solar eclipse to them is an event which had been calculated and predicted. Their verdict will always be: Somebody is to blame; explosions are caused by ignorance or neglect. And so with economy, for to them the furnace will be a sort of gas retort and the burning of coal a scientific study; to them, the boiler, a giant struggling against almost equal odds, harassed by conflicting expansions and contractions, constant and varying strains, attacked by corrosion and injured by scale. They will know it as a magazine of enormous power, in which each cubic foot of water has the explosive energy stored within it of a pound of gunpowder, and to them eternal vigilance will be the price of safety. Certainly then it does appear strange that for such a charge we should employ cheap labor; strange it is that the most ignorant man about the establishment is the favorite fireman. For my part it is incomprehensible how either practical men or those of ordinary business sagacity can feel willing to discount the chances against such a course.

Nevertheless, the engineer of to-day is confronted with these conditions and the safety and economy of his "plant" become of imperative importance to his success. In these two connections then, I desire for a few moments the indulgence of your attention, for the purpose of submitting to your judgment, certain facts which bear upon the importance of providing some method whereby a surveillance over the steam pressure may be had; for accurate and full information as to the management of our boilers should always prove useful and interesting.

Upon the question of safety, it requires no demonstration to prove that whatever impairs the boiler's strength or durability should be prevented. To make such prevention possible, however, presupposes the means whereby the preventable occurrence may become known. If, therefore, fluctuating or excessive steam pressures are injurious how are we to be made aware of their occurrence? Obviously but one method exists, and that is by resort to automatic steam-written records from which we can determine the departure from conservative limits. Assuming that the ordinary steam gauge which only indicates the pressure at the instant is entitled to the great confidence bestowed upon it, it undeniably lacks the ability to afford us any more information, as to the pressure of the previous moment, than the proverbial dead man, who can tell no tales. In fact for many years, owing to sharp competition they have been so poorly constructed that they are even dangerous to use, because many are liable to rely upon them for the determination of the pressure they are at the time carrying and even go so far as to adjust their safety valve weights to blow with the gauge. The dials are first produced, by different methods, in large quantities, all alike and the springs taken afterwards which will come the nearest to the "travel" called for by the dial so laid out, whereas, each spring has its own "travel" and its dial should be laid off accordingly and a suitable price demanded for the article when made, as a cheap and unreliable steam-gauge, is dangerous and dear at any price.

When, however, only one of these is relied upon for twenty years it is apt to be inaccurate. Last month I came across one such in a state hospital, which was ten pounds out. In this case the pipe leading to it was stopped up by dirt, etc., so the pressure rose and fell not with the pressure but soon after, the change occurring when the condensed steam "water" could soak through the obstruction. Instead, therefore, of relying solely upon the ordinary indicating instrument, whether it be entitled to such confidence or not, common prudence would dictate the employment of more than one gauge and preferably that the supernumerary should be a recording machine.

The records of steam pressures carried have a large prudential value for the reason that with their use a fireman must give up his position or do what he is required. For instance if a careless man lets his steam get too high before he discovers it and the safety valve does not blow as calculated upon for any of the causes common in such cases, who other than the fireman, will be any the wiser and when will the remedy for a careless fireman, or faulty or overloaded safety valve be applied?

It is generally supposed to be necessary to first know of a trouble before its remedy can be either determined or applied The only way, therefore, to know whether one's boilers are exposed to excessive pressure or not, is to use a gauge which records the pressure Occurrences are constantly happening under conditions, which may be described by that smooth-sounding term "banked fires" which would electrify every hair of one's head if revealed to those who have so much at stake and who think such fires harmless. A strong fire toward stopping time leaves the boiler setting so hot as to supply sufficient heat for running up the pressure beyond what a cold setting could do. Yet when the fires are once "banked" the man "lets up" on his watchfulness, and generally the boiler is left entirely alone for a long interval. "We never carry steam at night as we bank our fires, and in the day time have a good careful man around," is an expression common to most steam-users, but a few moments' reflection will generally convince them that they have assumed a very ridiculous and untenable position. The police of our cities frequently find steam blowing off from boilers under the sidewalk during their nightly perambulations and they have learned that it issues from one of those places where they "never carry steam at night" and he routs somebody out in the building or neighborhood to remedy the trouble. One summer recently while stopping in a manufacturing town, I heard a shrill whistle blow for two or three hours during the night, and concluded as I learned the next morning, that it was a low water alarm. The police hunted up an engineer to go to the establishment and give the boiler some water, and fortunately the boiler took the engineer's proffered kindness without getting up and going off and out of shape about it, either.

A case occurred last October, under one of the costliest buildings on Broadway, New York, where fires are banked and they "never carry steam at night." It appeared, however, from the recording gauge chart the next morning that something had caused the recorder to make a high steam line a good part of the night, and investigation proved that the night watchman heard a roaring noise when in the top of the building, and concluding that it must be the boiler "blowing" about something, he clambered down twelve or thirteen stories and found the damper closed and a full pressure on. Of course, it goes without saying that if the valve had been fast in the seat, or the weight shifted on the lever from any cause, a first-class explosion would have followed. These boilers are provided with an approved pattern of damper regulator on the main flue and also have individual dampers on the branches from each boiler leading into the main flue. The individual dampers are, of course, for shutting off either boiler when not in use. The trouble was caused by the fireman who either did not know enough, or forgot to unhook his automatic regulator connection before leaving for the night. When the banked fire and heated walls had radiated sufficient heat the pressure of steam closed the damper and the heat being entirely shut in with no air passage left open to the chimney and little or no steam used in the building, the "safety valve" was called upon and fortunately it did its duty by preventing the steam from passing beyond the limit as shown by the chart.

In the same establishment only two months later, on New Year's morning, the night watchman closed the furnace doors at the usual hour so the fires would be in better condition for the day fireman when he arrived. The day man did not arrive until some two hours later than usual, as it was a holiday, and so the steam went up again, startling the neighborhood with the racket for an hour or so. The day man claimed that he told the watchman not to close the doors until a later hour, a statement which the latter denies. Be that as it may, in both instances the chart, daily submitted to the manager of the property, revealed the occurrences and caused an investigation which result in more correct methods of transmitting orders so that the regulator was unhooked while under "bank fires" and the night watchman was directed to make more frequent visits to the boiler room. Who can deny that in this instance, indifferent methods would ultimately have resulted in the explosion of the boiler? The recording gauge had unmasked the facts and had caused the proprietor to put in force needed rules. If an ounce of prevention is better than a pound of cure the instrument repaid its first cost in these two instances alone.

Self interest should suggest the use of such a safety appliance, particularly as all persons are supposed to intend the natural consequence of their acts, for proof of an act, or course of precedure, which was adopted or persisted in to deceive the public or in defiance of its safety is sufficient proof of the intent to jeopardize unless the doer establishes innocence of such intent and knowledge. The burden of proof rests on him. If therefore it be true that no steam boiler "plant" can be conducted as intelligently, economically, or safely without the information and aid supplied by the pressure-recording instrument as with it, then proof of negligence can be made out by establishing the fact that such a valuable monitor and means of information as the pressure recorder had been rejected and failure to secure such an instrument may be properly urged in courts of law as evidence of negligence.

Even so important a matter as the amount of pressure applied by an authorized inspector in testing a boiler with hot water, has shown that only an excess of eight pounds was put upon an old boiler which is regularly carrying from 55 to 60 pounds pressure of steam. The record further shows the pressure to have been "jumped on" for an instant and then released, allowing no time for inspection of the seams etc., while under the testing pressure. No satisfactory reason has been obtained, so far, for this improper method of testing, but the fact has been established, and so much gained. Certainly more confidence could be reposed in a test where the record shows that the boiler sustained the testing pressure for five or ten minutes, during which time the testing engineer could be presumed to have been examining the boiler for evidence under such strain.

Another matter revealed frequently by the recording gauge chart is the custom indulged in by many attendants of "bottling up steam" a few minutes before starting time in the morning, at noon, and in some cases just before cleaning fires. Of course such prejudicial practice is the simple outgrowth of ignorance, concerning the limited amount of steam quantity they can "bottle up," and the very small service it can render, compared with the injury, when persisted in, it ultimately causes the boiler. Aside from this objection, the practice is exceedingly pernicious, because only a few moments' neglect would cause the pressure to accumulate, to the point at which the safety valve is supposed to open; then, if it happens to be inoperative, an accident would almost certainly follow. No excuse should be taken in any shape, under any kind of reasoning, for "bottling up steam." If the generating capacity of the boiler is not equal to the current demand, it cannot be helped by simply bottling up; in fact, it has been my experience that where the record line has been extremely crooked, upon the first introduction of the recorder, the effect of such record has been to cause a much more uniform line from day to day, until the nearest approach to uniformity has been reached, consistent with the vicissitudes of the demand for steam.

A steam user once apologized for the appearance of his record, saying that the steam was drawn from the boiler at irregular periods by persons in the mill, and consequently the fireman could not carry any very regular line; that his use of steam was different from that in most places, etc. Noticing, apparently, my incredulity, he asked if I disagreed with him. My reply was: "Do you suppose that the steam necessarily falls as low as this record indicates?" In other words, I called his attention to the fact that where a fireman is on the keen lookout for his boiler pressure and water level, he will readily detect the pointer hand of his gauge the moment it begins to rise or fall, and govern himself accordingly. For instance, if he sees the hand indicating that the pressure is falling, he will avail himself of the opportunity to slow down his feed, and perhaps open his damper wider, and if his fires are in prime condition, withhold fresh coal for a few moments; then, when the onslaught upon his boiler has ceased, and the hand of his gauge is stationary, or starts to move upward, he will at once set about to replenish his coal and water, and so have his conditions favorable in a few moments for another attack upon his steam supply. When his steam is raising he can afford to feed and to fire, and his thought should be to have everything in prime condition while he has surplus power and opportunity. Then he would not be caught so badly when these extreme attacks were made upon him. The cause of these extreme fluctuations then are largely due to the fact that he is unprepared to meet these emergencies, and, becoming alarmed when his steam has fallen twenty or thirty pounds, he attempts to get it up by replenishing his fire, as it seriously needs it, with coal, a course which only tends, for the time being, to reduce the pressure still more, until the fuel has delivered its gases and is ready for combustion. After this explanation the proprietor shook his head, and said he had never thought of it in that light, and that he would have to call John and talk with him. The result of this was that the man's record never fluctuated in the same way again, and that the average steam line showed constant attention to firing frequently in small quantities, and thus he kept himself in shape to meet emergencies.

Undoubtedly, the man had to work a little harder at first, but afterwards it was easier, because he properly understood the matter and manipulated his fires accordingly. The suggestion from the proprietor was exceedingly valuable. It resulted in the proprietor teaching his man, and in mutual regard afterward, because it showed that the man was capable and willing to be taught, and that the proprietor had evidence of the resulting fidelity. The dissemination of knowledge among firemen can certainly do no harm, and when it reaches a man who desires to hold his position and give satisfaction, it will do much good. Men uneducated to the science and ignorant of what constitutes firing steam boilers, can hardly be expected to act upon the knowledge which others possess professionally. Some men will fill a furnace full of coal, so as to have more time to walk around. After a time up goes the steam pressure, because more steam and heat are generated than wanted; then the feed-water is turned on, the water level is run up so as to keep the steam pressure down; the safety valve may blow, or not; the damper is closed; the fires smolder; large quantities of carbonic oxide gas goes up the chimney, and this means an escape of unconsumed fuel, which means dollars and cents. After a while, the fires burn lower, and down goes the steam, helped down, it may be, by another dose of coal. We can imagine the final effects on boilers used in such a manner. The position may be considered an humble one by some persons, but he is a man for all that, and his pride in what he can do is a stronger spur than anything else; let him see that you care for what he is doing. Take a careful interest in his work, and let him understand furthermore that his own grading depends upon himself, as established by his records; then you are in a fair way to have confidence in your man, and in your safety, and also feel assured of economy of fuel. But eventually you must pay him what he is worth. If not, some one else will be glad to have him. Suppose for instance, a man who burns three tons a day is paid two dollars for such services, and in so doing he is wasting as little as 10 per cent. If coal costs $4 50 per ton, the loss will be $1.35 per day, or what is equivalent to paying a man $3.35 per day who can save this amount. When the consumption of coal amounts to say, 8,000 tons per month the saving of only 10 per cent amounts to $80 per day, a small portion of which, if offered as a premium to the men who use this coal, would go a long way toward saving the remainder. What is wanted is the maximum of steam for

a dollar's worth of coal. Much can be saved by the manner of its use, and it is within limits, furthermore, to say that from five to ten per cent. is frequently wasted by firemen not qualified as such, and entirely ignorant or indifferent regarding the question of complete combustion. Certainly it is of vastly more importance to a proprietor, both on a score of safety and economy, that his firemen shall be men trained in the art of properly burning the fuel, than that his engineer should understand the question, particularly if the latter does not impart the information to the firemen. The practical value, therefore, of the steam record is in this connection, that it compels the fireman to give close attention and maintain uniform water level. Uniform steam pressure can not be had with anything short of the closest scrutiny of the steam gauge, which means economy of fuel and safety as well. The explanation of the charts has given much information touching unexpected occurrences, and innumerable other instances might be cited which would only tend to exhibit the surprisingly large number of contingencies possible wherever steam is used. When these facts become more generally known by those who are not at present deriving information from such instruments there will be extended and more careful methods of caring for steam boilers under pressure, and changes will be inaugurated which will ultimately result not only in greater economy of fuel, but in a greater degree of immunity from those disastrous explosions, which destroy so many lives and so much property annually.

DR. MOSES: I would like to ask Mr. Church what is about the average size of independent engine that he would recommend.

MR. CHURCH: I think the question is not governed by the size of the engine. I think it is governed by the size of the dynamo, and that in turn is governed by the nature of the circuits which have to be laid out. You have to discover what your distribution of light is to be; then adapt your dynamos to that; then adapt your engine to the dynamos. It is not a primary question.

DR. MOSES: Is it not in this regard, perhaps? It might not be considered advisable to establish a central station that did not represent a certain curve of use of incandescent light.

MR. CHURCH: Without professing to have any knowledge whatever of the economics of station management, it seems to me that a large station will naturally run in the direction of uniform sizes of dynamos throughout, for the one reason that that involves simply the carrying of one line of spare parts, and more ready interchangeability. Of course, in a station in which the light fluctuates as much as in this that I show, the smallest dynamo should be adapted to the minimum load that obtains over the greatest length of time. But I should determine as far as possible what my minimum load was to be, make that my smallest unit, and after that bring all the subsequent units to the same power, or if found better, to still larger units, as indicated here.

DR. MOSES: Does not the efficacy of these independent engines depend also a great deal upon the simplicity of the engine? If you have a complicated very high speed engine that requires a great deal of attention, oiling and looking out for cylinder heads and all that, is it not perhaps advisable to adopt in those cases an exceedingly simple engine? I have in my mind a station I saw in Philadelphia. The gentleman who represents it might now say something in regard to it.

MR. CHURCH: I simply wanted to say with reference to that question that I sometimes play whist. I do not wish the gentlemen present to think that I have returned my partner's lead in this case. [Applause.] I should rather be excused entirely from entering at all upon remarks of that character. I think the association will do me the credit by acknowledging that I made my remarks as general as possible. It is purely a point as to whether we shall go direct from our engine to our dynamo or shall we go around from the elbow to the thumb. I would not want to enter into discrimination between engines at all. [Applause.]

DR. MOSES: I feel, Mr. President, as if we are all here for the purpose of eliciting the truth on that matter. I myself am very anxious to know that, because I happened on one occasion to require the use of a high speed engine, and found that it was a very difficult thing to manage where the complication of the engine interfered with the ease of mind of the engineer. He had to be running it nearly all the time. His attention was nearly always occupied with it. Therefore, I asked that question. I answered it for myself on a subsequent occasion where I caused an engine of very much simpler construction to be substituted for it. I won't tell these gentlemen that it was an engine that he represented, or he might object to it. But it was. [Laughter.]

MR. SMITH, of Detroit: I think that Mr. Church has treated this question from a very broad standpoint, and I think that he should be congratulated on that. There are certainly at least half a dozen high speed engines admirably adapted for electric lighting, and anything Mr. Church has said on the blackboard in reference to any one of them will apply to all. I do not see any reason for bringing in here the different makes of engines. I am not an engine man myself. I do not represent any engine at all. But Mr. Church's paper was put on a board basis, and I think we should keep it on a broad basis, and not bring it down to any particularity.

MR. SMITH, of Pittsburgh: Mr. Church's paper is limited to incandescent stations. The use of a small engine in arc stations has been very much condemned. In an arc station you know about what your light is going to be. If you know your load is going to be 500 horse power, you can stop your engine at pretty nearly its full load. There the big engine is undoubtedly the more economical. But in an incandescent station there is no regulation as to the amount of load. We must keep that point clearly before us—that this discussion is limited exclusively to incandescent work. There are comparatively few incandescent stations that are running with shafting. Most of them are running with independent engines.

MR. KERR: There is another thing, in the preliminary part of this discussion, that I wish to draw attention to. It has been called to the attention of the association each time a power discussion has arisen, and I do not see the need of mentioning it again, except for the fact that a great many men have a misconception of large versus small engines as against sub-divided versus non-subdivided power. Let us not in any discussions that follow here talk about the difference between 60-horse engines and 100-horse engines, and whether it is better to have 60, or 75, or 125 horse power. The thing is a broad matter, and not limited to the size of the engine. It is sub-division versus non-sub-division.

MR. SMITH of Detroit: Mr. Church spoke about the economy of small engines as compared with large ones. He is perfectly right in that, because the greatest loss in power is always on the small load. But I think that the question might be carried a little bit farther. The high speed engines, as a rule, are not as economical in coal as the larger engines, for the reason that we cannot get as perfect expansion; we cannot get as good compression lines on a single valve automatic engine as we can on an engine with four valves as in the Corliss type. But there is another means of getting at that economy which is due to high expansion and that is in compounding. It is known that all the ocean steamers now are run on triple compounds; that is the steam is taken at high pressure in one cylinder and expanded into the second cylinder and from the second into the third, and the very highest economy that has yet been gained has been attained with those engines. Now the same thing can be done with the high speed automatic engines which we are now using for electric lighting and with very great economy, and the tendency, I think, which has already started in Europe is coming to this country and we will very shortly have economical high speed constant revolutions and constant regulating in the engines for direct running of dynamos. There are, as I understand, several of the prominent engine builders now who are bringing out compound engines for high speeds and I think the economy that has been talked about for the large slow speed engines will be met in that particular very shortly.

MR. KERR: Mr. Smith has made a remark about which I would like to argue with him, without taking the time of the meeting to do it, about the compression not being as good on a single valve engine as on a four valve engine—

MR SMITH: Do not let Mr. Kerr forget the idea that I am not in favor of high compression.

MR. KERR: Perhaps it may take but a moment to explain. On a slow running engine you set the exhaust valve so that it makes an exhaust closure at ⅞ of the stroke. That does not vary as the load decreases. Therefore the entire internal surface of the cylinder is exposed to the temperature of the exhaust steam at the whole stroke, or ⅞ of it. With a single valve engine, as the cut-off decreases the exhaust closure occurs earlier, until when you get down to a very light load, you only expose your cylinder for one-fourth of the time to the temperature of the exhaust steam; and therefore the movement of the compression of a single valve engine not only is better under light loads than a four valve engine, but it is very much better.

MR. SMITH: If I understand it rightly, the lighter the load, the shorter the cut-off, the greater the compression. Therefore a greater surface of the cylinder is exposed to condensed steam than in the other.

MR. KERR: Therefore a less time is given for the bad influence of the temperature of the exhaust steam to be exerted on the surface of the cylinder. This is a very long discussion; we will continue it in our next. [Laughter.]

MR. RICE: Mr. Kerr made the statement that it was not small engines versus large engines, but the division of power versus the non-division of power. Now it seems to me there is not a member here who would not agree to the sub-division of power, broadly taken, in cases where the loads vary largely. We all agree to that. I do not believe any man can dispute that one moment. It seems to me the question comes down to the relative efficiency of the engine direct from the dynamo—a high speed engine—and driven by means of countershafting by a large engine. Suppose you have a station of 2,500 horse power. Now the question is is it more economical to use that 2,500 horse power engine or to put in a number of 100 horse power engines; the 100 horse power engines driving direct; the 2,500 driving from a countershaft?

MR. KERR: That was the subject of Mr. Church's paper.

MR. CHURCH: I think I did allude to that. I said that the smallest unit should be adapted to the lightest load. I am disposed to take a very practical view of this question. I think there is but one way to settle this thing absolutely and finally, as to which is the most economical, and that is not to argue it from any standard of compression lines or any theoretical data; but to take the results of those stations which operate two systems, and extend it into the cost of the various items per lamp hour. That will settle it. Every well managed station has its nightly report sheet. Extend the one item of coal alone out to its course per lamp hour. That will give the relative coal economy; but that is not enough. Then you must extend the collateral items of repairs and all these various items extended out per lamp hour, and then you can combine them and ascertain what the grand total is as to the question of direct or countershafted engines. Anything short of that is argument and not demonstration.

MR. WRIGHT: I have recently taken charge of a station in New England where we are using large engines with countershafting. We are using somewhere near 5 1-5 pounds of coal per horse power per hour, which I attribute in a great measure to our want of sub-divided power. Of course there we have an extreme case. But it will not be an extreme case in the future. On Saturday night only do we have an ampere line that approaches anywhere near Mr. Church's illustration. On the ordinary week days we close at 6 o'clock, so that our highest ampere line is maintained for a short time only and then very rapidly falls. I happen to have here with me some papers I brought for Mr. Church. I promised them to him a long time ago, and in preparing to come to Pittsburgh I happened to remember them and copied them to bring them with me, and if Mr. Church will allow me for a moment to change his diagram for a little bit I will show you where our line comes. I think Mr. Church has shown us conclusively that there is a saving here with the load maintained for several hours at its maximum. Now how much greater must it be if I get a load for five days in the week? That is more like that. [Illustrating.] We are coming to the time when we will all have early closing and our loads will be maintained for a very short time.

MR. SMITH, of Pittsburgh: Has any one noticed this peculiarity of our service in Pittsburgh? If it is dark for an hour in the morning, between 9 and 10 o'clock, our ampere curve will jump away up. No matter how bright the day gets after that, it does not drop any. [Laughter.]

MR. KERR: Mr. Church's paper mentioned the difficulty of driving incandescent lamps from very slow speed engines, on account of the fluctuation from revolution to revolution. That is a thing which can be noticed in a great many places. There is another thing which goes hand in hand with that. It is quite a well known fact that a slow speed engine has comparatively small friction. It is generally acknowledged so. The friction of the engine is small. Now put fly wheel enough on a slow speed engine, so that it won't make the lamps flicker, and you will find that it has a very large friction. The reason that a slow speed engine has small friction is because it has not fly wheel enough, and the number of tons of fly wheel to give it good regulation makes it a high friction engine. That is a thing which is very little thought of in electric lighting, and when thought of is only thought of too late; when they take out the first fly wheel and put in a second. That applies not at all to our class.

THE VICE PRESIDENT: If there is no further discussion of these topics, the papers will be received and spread on the minutes, and the subject will be passed.

We will now hear from Mr. Barton, on underwrite rules.

THE RELATION OF ELECTRIC LIGHTING TO FIRE INSURANCE.

BY S. E. BARTON.

In considering the relation between electric light and fire insurance interests, I must confine myself mainly to the situation in New England, because I am familar with what has been and is now being done there, and I am just as unfamiliar, except in a general way, with the relations that exist between the two interests outside of that small but lively quarter of our country. In order that you who live away from New England may better understand what I may say as I proceed, it will be well for me to tell you briefly what kind of insurance organization we have there.

The New England insurance exchange, which exercises a modest control over a part of the fire insurance matters within that territory, with the exception of the city of Boston and state of New Hampshire, is a body composed of the special agents, adjusters, travelling men, or so-called "field men," representing the various stock fire insurance companies doing business there, some one hundred and fifty in number. These men mostly have their headquarters in Boston, which is verily a "Hub" in that respect. They are constantly skirmishing the territory, individually or in squads of two or more, adjusting losses, and ocasionally, through the co-operation of their local agents in the towns and cities, stealing good risks from each other or from some other competitor; but every Saturday finds a large majority of them back in Boston, where they convene in regular session and consider, with legislative dignity, any matter of common interest, electric lights included. They swap experiences, swap yarns, swap anything for something better; consequently they are a body of wonderful unanimity in any cause that promises common good to themselves and justice and fairness to others. They say to electric lights, "burn," after our inspector has approved the manner in which you are installed and maintained; and as a consequence there are in New England today, not including Boston and New Hampshire, 13,944 arc and 157,848 incandescent lamps radiating their beautiful bright light where the feeble flicker of the gas jet and kerosene lamp could not penetrate. So concerted is the action of these men, that were they, by reason of any necessity compelled to say that electric lights should not burn, comparative darkness would once more reign supreme in that fair land; but while they continue to count upon their fingers the yearly fires caused by this modern illuminant, I think I can safely assure you that their dreaded power of exguishment will not be excercised. I have made exceptions of the city of Boston and state of New Hampshire, and the reasons are these: The former, in its fire insurance matters, is supervised by a similar organization to ours, known as the Boston Underwriters Union, which handles electric lights in the same manner as our exchange. The latter, through antagonistic and unfair legislation over two years ago, caused the absolute retirement from that state of every outside stock fire insurance company and they now manage that business themselves. By what light they work, we know not, but judging from their sad experiences of the past year, we are ed to believe that they work by the unholy light of their own wicked ways.

I have described the character of our exchange, principally to show the difference between it and most of the insurance organizations of our country, which are generally composed of officers of companies, or local or general agents in the large cities, between whom, by reason of their greater competitive relations, there exists a less disposition harmoniously and successfully to devise and carry out methods of improvement and mutual good. In the first year of our existence, some five years ago, we realized, after paying considerable sums for losses caused by electric lights, that our interest demanded the inspection of all such apparatus by some person selected by ourselves, if we were to continue granting permits for the lights without charge. We were for a year or two in a sort of experimental way getting

settled down to a perfect system of inspection, but the result of the last two years immediately preceding 1887 showed us, for the labor we had undertaken, a loss of less than $8,000 from electric lighting, in our territory. We had by that time not only given up all thought of making an extra charge for a permit to use your lights, as we do in many cases for kerosene oil, and in some instances for gas, but we were fast beginning to show our preference for your illuminant by granting reductions in our rates.

The year 1887 has shown us a loss record from your lights something less than any previous year, notwithstanding the great increase in your installations; and the spirit of recognition of your superiority in point of safety has steadily gained ground, until, I am happy to predict, that before another month has passed the New England Insurance exchange will have announced its favor in the form of a schedule of reduced rates, which it purposes to make on certain classes of risks where the exclusive use of electric lights is guaranteed. I think that in this respect we will have fairly taken the lead.

A proposition to this end was made by the electric light committee of our exchange a year ago, but while we had for two years previous made an occasional reduction in rates, and have done so more generally during the past year, the time has not seemed ripe until now for an open announcement to that effect. This feeling of preference for electric lights has been very gradual in gaining ground with us, and has reached a general recognition from the fact that the fires from that source have been few in number and the losses small in amount, and this favorable result has most assuredly been due to our perfect system of inspection.

In this claim I am supported by the greatly increased number of fires that are reported as occurring in sections where insurance inspection does not prevail. That there are in your method of lighting many inherent possibilities of causing combustion and loss of property, I need not claim, because none of you would for a moment deny it; but what I do claim, and mean to persist in maintaining, is that there is no reasonable excuse for any fire to be caused by your apparatus, except in very rare cases, where some unexpected and unavoidable accident may occur. It is quite possible for you to reduce the fire hazard of your system to the very lowest degree. It is quite impossible to do so with any other means of artificial lighting.

How can any care or control be exercised over the promiscuous use of kerosene lamps, while men, women and children are handling them? What can prevent the innocent but agile cat from upsetting the lamp carelessly left in its path, as it is not infrequently accused of doing? Surely no insurance inspector, even with his ubiquitous habits, could prevent such catastrophes. While greater care, and a system of inspection could prevent many explosions in the gas system, they could not prevent combustible material from coming into contact with the open flame, neither in the dwelling, the store nor the workshop, nor could they prevent an accidental escape of gas through a leak, or a burner carelessly left open, and in that event no amount of cautionary rules could deter the innocent occupants of the premises from going in search of the leak with an open light in their hands.

While our policies distinctly exclude damage caused by explosion, unless fire ensues, and then only cover the damage *by fire*, there is usually fire enough to "ring us in," and the drawing of the line between the explosion and the fire is usually disastrous to us. Therefore I hold that, while no possible human foresight can prevent fires from the old methods of lighting, it is not only possible, but quite an easy matter, to prevent them in your case, if you set about it rightly.

If I were to presume to offer advice in the matter, it would be this: — Where insurance inspection is already being practiced, combine among yourselves and support it by paying whatever is reasonable for carrying on the work in an intelligent and economical manner; also by helping to improve the rules and requirements from time to time as your experience develops new means of safety.

Where such work is not being performed, get together in the same manner, those of you who are operating in that field, and ask the insurance men to appoint an inspector; then submit your work to him, conform cheerfully to his reasonable requirements, and go to the public with his approval. The approval by insurance companies of any lighting, heating or power device is necessary. The public wants light, heat and power, but it must have insurance, for on that the great commercial fabric of to-day depends for solidity. By such inspection you will bring the fire hazard down to the minimum; you will largely increase the growing confidence of the public in your lights; you will rapidly clear away any lingering prejudice with insurance men against you, and in place of opposition that you may now occasionally meet with from them, you will readily obtain their fullest endorsement; more than that even, you will doubtless receive positive encouragement from them in the way of concessions in rates, in many cases.

The two interests should harmonize and work together to the greatest degree. You have in your system of artificial lighting great possibilities of reducing the enormous fire waste considerably; while we have, through our endorsement and encouragement, the power to largely increase your development; and the two together can give mankind more light and better light, and it needs it. I do not hold that you are deficient in any degree as to what does and what does not insure safety in your work, but I think that you will agree that in the construction and maintenance of your equipment you are sometimes obliged to depend upon those who are not so proficient in their calling as they might be. The good insurance inspector, who gleans his knowledge and experience from all, helps you to educate and improve in usefulness those employes to whom you entrust your work. I refer particularly to the construction and dynamo men, and the trimmer,— to the last more particularly. If this functionary had possessed a knowledge of the possibilities of fire from the arc lamp, the losses from electric lighting in New England last year would have been too inconsiderable to mention.

Right here I wish to speak of the practice that sometimes possesses local companies, that of hiring inexperienced help because it is cheap. It is false economy, I think. Competition, which is very great among you, drives you in some cases to lowering the standard of your material and work. It compels you to figure in every possible way to get a job. Nine of you may be honestly inclined to maintain the highest degree of perfection, but the tenth one outbids you all by figuring for cheap work. Careful and conscientious insurance inspection brings him up to the rack, or shuts him out, and we all profit thereby.

The question of insulation was referred to in a pointed and timely manner by our friend Haskins, a year ago, and his suggestions seem to have taken root in the east. Insulated wire is now the rule, rather than the exception, in those places where insulation is most needed, and painted wire has "lost its grip." The difference in the cost is too slight, and, in point of efficiency and economy too great to allow the reform to languish.

The location of central stations seem to be receiving merited attention, but not to that extent which the good of the profession demands. In the past, the practice has been to secure power, especially in the smaller places, where it could be had the cheapest, without regard to permanency and surroundings. The result has been that you have gone into cramped quarters, with hazardous occupations on all sides, above and below you. You have got power by using boilers already being worked well up to the limit of safety, or you have set other boilers in the limited space at your disposal. There have been fires and losses charged to you which you might have escaped by locating more wisely, and as a consequence too many insurance men now look upon the electric light station as one of the hazardous risks. Locate by yourselves as much as possible, build after modern fashions; do not spare brick walls and cement floors where they will add to your safety, and then you will get lower rates from stock fire insurance companies, or our mutual friend, Woodbury, will provide for you.

There are in New England, as many of you are aware, a dozen or more good, strong mutual fire insurance companies, known as the Manufacturers' Mutuals. They confine their acceptances of risks to the largest and best manufacturing properties in New England and the Middle States, and, to a limited extent, in the Southern States and Dominion of Canada. C. J. H. Woodbury is one of the vice presidents of the largest of these mutual companies, and the recognized expert authority for them all. About 500 of the large manufacturies insured by them are lighted by electricity, either arc or incandescent, to a large extent isolated plants. They have received the inspection of Mr. Woodbury, and the greater part of those in New England, that of Inspector Brophy, also, I take pleasure in quoting from a letter on the subject recently received by me from Mr. Woodbury. He says: "When electric lighting was first introduced, it was the cause of a great many fires, there having been twenty-three fires from this source in the sixty-one mills using it in 1881 and 1882. By April, 1882, all the electric lighting plants in property which was insured by the mutuals, had been changed to conform to the rules for installation which I had prepared in December, of the previous year, and since that time we have not had a single fire from electric illumination. I do not know of any fires caused by electric lights which did not owe their origin to a disregard of principles laid down in these rules as essential for safety." I think that statement bears me out in my assumption as to the almost entire immunity from fires due to artificial lighting that is attainable by the use of your methods, and I ask no better support.

Mr. Ridlon has advanced some excellent ideas looking to better work, in point of safety, in construction and maintenance—that of examination for fitness and qualification, of the men who do this work, and the granting of certificates to them, if found competent, the same as is done in the case of steam engineers. He would have the board of examiners composed of electrcial and insurance experts. The absolutely impartial inspector is still needed to see that the "tenth man," of whom I have previously spoken, does not prosecute his nefarious work without a certificate; also to see that those who hold certificates are not intrusting their work to cheap men who don't hold them or that the guileless trimmer is not falling into the habit of leaving the bottom off his arc lamps.

I would not occupy your time with technical suggestions, if, indeed, I had any to offer, because they had better be left to printed rules and inspectors; but it may interest you to know to what extent your business has prospered in New England. The following figures are taken from our inspection record and are probably about correct. They are inclusive of Boston but exclusive of New Hampshire. For comparative purposes, I give them as they stood at the beginning of 1886 and also 1888.

NUMBER OF ARC LIGHT CENTRAL STATIONS.

	1886.	*1888*
Massachusetts	26	45
Rhode Island	5	8
Connecticut	9	21
Maine	4	14
Vermont	--	5
Totals	44	93

Increase of 1888 over 1886, 111 per cent.

CAPACITY OF FOREGOING IN ARC LAMPS.

	1886.	*1888.*
Massachusetts, (including 2,168 in Boston in 1886, and 2,475 in Boston in 1888)	3,693	7,305
Rhode Island	831	1,961
Connecticut	782	3,311
Maine	520	1,465
Vermont	----	415
Totals	5,826	14,457

Increase of 1888 over 1886, 148 per cent.

NUMBER OF INCANDESCENT LAMPS FROM CENTRAL STATIONS.

	1886.	*1888.*
Massachusetts, (including 9,000 in Boston in 1888)	8,600	74,500
Rhode Island	600	2,200
Connecticut	----	11,050
Maine	400	8,100
Vermont	----	1,400
Totals	9,600	97,250

Increase of 1888 over 1886, 913 per cent.

NUMBER OF ARC LAMPS IN ISOLATED PLANTS.

	1886.	*1888.*
Massachusetts	459	721
Rhode Island	416	731
Connecticut	223	332
Maine	10	50
Vermont	58	128
Totals	1,166	1,962

Increase, 1888 over 1886, 68 per cent.

NUMBER OF INCANDESCENT LAMPS IN ISOLATED PLANTS.

	1886.	*1888.*
Massachusetts	16,003	40,619
Rhode Island	4,140	9,546
Connecticut	2,117	11,050
Maine	1,860	6,908
Vermont	--	475
Totals	24,120	68,598

Increase, 1888 over 1886, 184 per cent.

SUMMARY.

TOTAL ARC LAMPS, 1886, 6,992; 1888, 16,419. Increase, 1888 over 1886, 135 per cent.

TOTAL INCANDESCENT LAMPS, 1886, 33,720; 1888, 165,848. Increase, 1888 over 1886, 392 per cent.

TOTAL ARC AND INCANDESCENT, 1886, 40,712; 1888, 182,267. Increase, 1888 over 1886, 348 per cent.

Those of you who know the ratio of increase in other sections of the country for the corresponding period, can judge if New England insurance supervision is a detriment to your business or otherwise. A whole year without any considerable fire loss in our country from electric lighting would be a splendid record, but none too good for any of us to contemplate. While such a result is far outside the bounds of probability in the present condition of things, it is well inside the bounds of possibility. As well might we hope to revolve the earth from east to west as to hope for anything short of millions of dollars of fire loss annually from the old methods of illuminating by combustion—the candles, the gas and the kerosene oil flame, and the accompanying friction match.

THE VICE PRESIDENT: Gentlemen, you have heard the paper of Mr. Barton. It is now open for discussion.

MR. BARTON: I think the showing in New England must be so good that there is nothing to say. It speaks for itself.

THE VICE PRESIDENT: If there is no objection, the paper will be received and spread upon the minutes, and the topic passed.

We will now hear from G. W. Parker, of St. Louis, on what constitutes a good carbon point.

WHAT CONSTITUTES A GOOD CARBON POINT.

BY G. W. PARKER.

From the standpoint of the manufacturer all well baked carbons that are straight, free from cracks and other similar defects, and made from pure material, are good carbons. The electric light engineer will say that no carbon is good unless it will center properly and give him a reasonably long life with a good light. He is not at all inquisitive as to the method of their manufacture, provided they give such results. But as the manufacturer can go no further than to correct any errors in his mechanical processes, the value of the carbon afterwards depends upon the conditions of its use. Such carbons as are described in the first paragraph will in some currents be satisfactory both as to light and life. In others the light may be brilliant and the life too short, or there may be arcs too short or too long, flaming, or other defects arising from the unsuitability of the carbon to the current, there being no inherent defect in the pencil itself. Therefore, to cover the whole ground of this important inquiry, we should also have the carefully compiled statements of your experience of the behavior of carbons burning in your lamps under varying circumstances. From these, results of great value to both sides might be obtained.

There appears to be no trouble in determining what constitutes a good carbon mechanically, but to you a good carbon means one that will give you satisfactory results in your use of it, and there we find several difficulties, without taking into account imperfections in your apparatus. The first is the difference in the strength of the current used in the different systems, and, also, in many cases in different plants of the same system, the corresponding differences in the resistance of each lamp, and frequently, unequal adjustments of lamps in the same plant. For convenience we are in the habit of referring to those systems in which a small current and a long arc is used as high tension systems, and those in which a large current and a short arc is used as low tension systems. The requirements of the low tension seems to be a carbon that is hard, well plated, and a good conductor, the last being the most important.

In the high tension, on the contrary, hardness and conductivity seem to be of secondary importance. There is a tendency to flame and burn unsteadily when a hard carbon is used in these systems, and a softer one sometimes becomes necessary, which in many cases shortens the time in

which a lamp will burn without being re-trimmed, but, in such case the difference is fully made up in the brilliancy of the light. On the other hand where a soft carbon is burned in a low tension current, the tendency is to form needle points which prevents the carbon from centering properly, causes them to heat and to burn the holder.

Let us pursue the inquiry touching the questions of size, conductivity, mortality and light, and asce tain if definite relations can be established in regard to them that may result in guiding us to the selection of perfect carbons for use from a mass of mechanically good carbons.

It is a matter of great interest to know in what manner and to what extent the size of the carbon affects the result in a current of given strength, covering, of course, in the general question of conductivity, the all-important results of life and light.

It is well known that a hard carbon offers less resistance to the current, or, in other words, has greater conductivity than a soft one; therefore, in carbons of the same length and diameter, made of the same material, by the same process, conductivity increases and diminishes respectively with their hardness and softness. In either hard or soft carbons whatever of conductivity they possess respectively will be increased or diminished as their diameters are increased or diminished, the length being maintained. It would appear, therefore, that it is possible to make a softer carbon of larger diameter that will be the equivalent, in conductiv ty, of a harder carbon of smaller diameter.

Of carbons of the same hardness and length, but having different diameters, the larger will, undoubtedly, outlive the smaller. Of carbons of the same diameter and length, but differing in hardness, the harder will outlive the softer. Therefore, a carbon of larger diameter, which is soft, may be equivalent to a smaller carbon which is hard, as to life, just as it has been shown to be equivalent in conductivity. The life of a carbon is. of course, dependent upon many vicissitudes, such as high winds, broken globes, etc.; but under the same conditions the statement made above is, undoubtedly, a fact.

It is well known and admitted that as between hard and soft carbons of the same diameter the latter will give a more brilliant light. It is just as well known that in case of hard carbons those of smaller diameter will, within certain limits, give a more brilliant light than those of a larger diameter.

On the above statement of facts it may be regarded as settled then that with the same diameter, but differing in hardness, the hard carbon will possess greater conductivity and have a longer life, but with less brilliancy of light, while the softer carbon will have less conductivity and a shorter life, with a more brilliant light. And, further, that with uniform hardness, but differing in diameter. the larger diameter will have the greater conductivity and longer life, with a less brilliant light; while the smaller diameter will have less conductivity and a shorter life, with a more brilliant light.

The foregoing statements indicate invariably that with greater conductivity light diminishes and life increases, and, conversely, that with diminished conductivity the brilliancy of the light is increased and the life shortened.

In corroboration of this it appears that a small, hard carbon is, practically, the equivalent of a larger, soft carbon, their conductivity being also equivalent.

Heretofore, it has been considered probable that the diameter, candle power, resistance per lamp, conductivity of the carbon point, and strength of current, are all interdependent, and a change in any of them will affect all the others, requiring a counteracting change or adjustment in some of them, in order to restore the proper relations between them. This, if so, you can readi y see is difficult to do; for part of the work is to be done by the manufacturer, and the remainder is under your control. On the other hand, if the deduction can be properly made from the statements herein presented, that the resistance of the carbon point will determine its capability in respect to light and life in the different currents, the trouble is practically removed. It is not impossible, I think, to construct a machine that will, at no great increase of cost, assort the carbons into groups of uniform resistance or conductivity. Then, with constant currents, clean lamps, perfect connections, and insu ation, you will ascertain practically that carbons mechanically good will prove to be good and uniformly so in actual service.

Much more could be written upon this interesting question, but this paper is already too long. I have noted for your discussion some important points which I hope your experience will enable you to determine definitely if they are well taken or not. I would be glad to have the whole question of the imperfect burning of carbon points thoroughly canvassed so that manufacturers would get some hints as to what may be done by them in the way of correction when the fault lies at their door. It is especially desirable to be informed if that very disagreeable feature in the burning of the carbons called "flaming" is always the effect of one particular cause and what that cause is

MR. PARKER: I would like to say to the convention that the points presented in this paper are very important to manufacturers of carbons. If they are well taken, the road seems to be open to the manufacturer of carbons that will be uniformly good. Mr. Morrison stated to me that probably the best plan would be to have this paper printed and laid on the desk of each member so that a discussion may be had upon it to-morrow. I can readily can see that the intricate points presented here cannot be understood by a simple reading, and if it is the pleasure of the convention this course will be pursued. I am having the paper printed. What I have read from is the proof.

THE VICE PRESIDENT: What disposition will you make of the paper?

MR. DUNCAN: I move sir, that the paper be received as it is, and the gentleman's request be complied with and that a time be fixed to-morrow afternoon for discussion.

The motion was carried.

MR. DUNCAN: I move that this association adjourn to 9:30 to-morrow morning.

The motion to adjourn until 9:30 A. M., to-morrow was then put and carried.

THURSDAY'S PROCEEDINGS.

The association met at 10 A. M., pursuant to adjournment.

THE PRESIDENT: The first business is, by special order, the amendment to the constitution, which the secretary will read.

The secretary read the resolution, that Article IV of the constitution be hereby amended to read as follows:

"The president and vice-presidents shall be elected by ballot to serve during the following meeting.

"The treasurer and secretary, who may be one and the same person, shall be nominated by the president, subject to the approval of the executive committee.

"The executive committee shall be chosen by ballot at each meeting, either annual, semi-annual or special, to hold office from the close of the meeting at which they are elected until the end of the meeting at which their successors are chosen."

MR. DECAMP: I move that the amendment be laid on the table.

MR. RIDLON: I hope that it will not be laid upon the table, as there are many reasons why it should be acted upon. The convention is liable to be held in different parts of the country, and it is very desirable that all the officers of the convention, or at least as many as possible, and more especially the president, who would probably be a prominent local man in the locality where the convention should be held, should preside over the convention when it is held in his place. We have a very large number of men who are eligible for the office of president, although perhaps none of them can fill Mr. Morrison's place. But still, when we go outside of Mr. Morrison, we have a large number that we can select from; and it would take some little time to go around through them. I hope that you will act on this measure and not lay it upon the table.

THE PRESIDENT: This is a very important matter, and I hope you will not call for the question until the members of the convention have all had a chance to speak, if they desire.

MR. LEGGETT: It seems to me that the action of the committee is in a proper line. At the Boston convention the same recommendation was made, but was laid upon the table. There is one suggestion that I would make in the nature of an amendment, and that is that the office of president shall be for one year, or at least until the annual meeting next succeeding; and that the executive committee shall be chosen to serve at each meeting. We have found here in this meeting the value of having the chairman of the executive committee at Pittsburgh; and you will find in each place great value in having the chairman of the executive committee at the place where the meeting is to be held. There is a great deal of work for the executive committee to do, and a great deal more work is thrown upon the members of it who are at the place where the meeting is to be held, than upon any other parties. If the chairman of the executive committee is selected from a place distant from the point where the meeting is to be held, it becomes a matter of very serious consideration as to what arrangements may be made for the entertainment of the committee or for its operations. On the general question of the selection of the president and vice-president of the association it seems to me it would be of great value to the association to have the positions of president and vice-president located about through the association so that all sections would feel interested in them. I think that there is nobody who would not feel flat ered and gratified to be selected to hold either one of those offices in this association, and to confine their selection to the localities where the meeting is to be held will make such a limitation as to leave out of consideration some parties who ought to be considered in that connection, and who come from regions where perhaps the meetings of the association would never be held. I, therefore, move, as an amendment, that the term of office of president and vice-president extend from the close of the meeting at which the appointment is made until the close of the next annual meeting. I hope the action of the committee will be considered and adopted and not laid upon the table

THE PRESIDENT: You have heard the amendment, what disposition will you make of it?

MR. MASON: May we hear it read again, the original motion with the amendment. Perhaps there are some here who did not hear the original resolution.

The amendment as reported by the committee, and the amendment offered by Mr. Leggett, were read by the secretary.

MR. WEEKS: That is precisely the way our constitution and by-laws now stand. As I understand it, the purpose of this amendment was to strengthen the hands of local parties in preparing and carrying out the objects of the association; and it was thought that if the president were chosen from the district where the next convention is to be held, that by virtue of his being the president of the National Electric Light association he would be able to accomplish a great deal more for the association in the convention over which he was to preside, than possibly would be accomplished by the chairman of an executive committee. That I believe was the main idea of those who suggested this amendment. It was further suggested by our president and others that the time will very soon come when we will not meet semi-annually but annually. During the early history of the association the developments in electric lighting have been so rapid that it has been an absolute necessity to meet semi-annually in order to keep pace with such developments; but our industry is becoming more and more nearly perfect every day; and the probabilities are that within a very short time an annual meeting will suffice.

MR. LEGGETT: I neglected in my amendment, to put the tail on; and I will add it now. I want to add this clause at the end of my amendment: "and shall not be eligible for election to the office for two successive terms."

MR. WEEKS: I might say that this matter as suggested, not by me, but by others with a view of carrying out certain suggestions that I had made with regard to holding a convention in the west: It had from time to time been brought to my attention that the association would like to receive an invitation from us in Kansas City to come out there and hold a convention. I had always answered to that that we had not at present sufficiently ample facilities in the way of hotel accommodations to meet the convenience of the association; but, as I have stated to some of you personally, we are now constructing two very fine hotels; and they will have a capacity of about 300 rooms. They will be first-class in all respects, and will be finished this next fall. I have suggested that your next annual convention be held in Kansas City. My reasons, and the reasons of others who have talked in this same direction, were simply these: On looking over our roll of members one cannot fail to be struck by the lack of western representatives. While in the west we have hundreds and hundreds of plants—nearly every city and town in Missouri, Illinois, Kansas, Nebraska and Colorado being provided with electric light plants—still they have not sent delegates to our convention; and on speaking to them personally about it I could not induce them to do so on account of the great expense of time and money necessary to come east to attend a meeting of the association. It has been thought that by holding a convention in Kansas City, if widely advertised for a while, we might bring in all these elements. It was with a view of carrying that matter out that this amendment was suggested. It was, as I understood it, with a view of selecting somebody in that locality for president of the association who could accomplish the most for the association in carrying out this matter.

MR. PHELPS: From the discussion of this topic, or of topics allied to it at the previous meeting, I infer that there may be a suggestion, or an objection in the minds of some to this very rapid change of officers, on account of there being danger of some lack of continuity in the work of the association, something omitted in the work as between one meeting and another; but it seems to me that that objection will still be met if anyone still entertains it, by the provision which I understand is to be made for a permanent secretary under compensation, who will be in a position to preserve the continuity of the work, and by keeping upon the executive committee a certain number of gentlemen from time to time, so that that committee, having charge chiefly of the work of the association, will be in a position to preserve this continuity and relation between the business of one session and that of the next. It seems to me therefore that the suggestion embodied in this amendment to secure a president, vice-president and chairman of the executive committee from the vicinity in which the meetings are to be held is eminently desirable.

After some discussion Mr. Leggett made a motion that article IV of the constitution be amended by adding at the end of the first clause, after the word "meeting," the following words: "and shall not be elegible for re-election for a next succeeding term." Making the article read: "The president and vice-presidents shall be elected by ballot to serve from the close of the annual meeting at which they are elected until the close of the next annual meeting, and shall not be eligible for re-election for the next succeeding term."

THE PRESIDENT: You have heard the amendment to the constitution offered by Mr. Leggett. Under the provisions of Article IX, this amendment goes to a committee to be appointed by the chair. I will name as such committee Mr. Leggett, Mr. Weeks and Mr. Duncan; and I instruct them to report at this meeting. The next thing in order will be the report of the committee for nominations for officers, but, in view of the action just had, I would suggest that the reading of that report be postponed until after the report of the committee just appointed. If there be no objection expressed it will be so ordered.

MR. DECAMP: I would like to ask if the duties of the committee just appointed to consider Mr. Leggett's amendment are confined to that particular amendment. In the report of the executive committee I think that there was a provision made for making the position of secretary and treasurer a salaried one That is not provided for in the constitution, as it seems to me it ought to be; and I think that will require an amendment to the constitution. I think it ought to be acted upon at this session; and if you will give me time I will frame an amendment, and it can go to the same committee.

THE PRESIDENT: You can have the floor for the amendment at any time you may wish. Then it can be referred to the same committee. Before proceeding to the regular order of business, E. Carpenter Smith, of Pittsburgh, desires to make an amendment.

MR. SMITH: I have much pleasure in announcing to the members of the convention that we have made an arrangement with the officers of the Philadelphia Gas company, through Mr. Westinghouse, to have their stand-pipe at 36th street lighted at seven o'clock this evening; and members who have not seen it, will find it of interest. I may say that it is equivalent to the lighting of one of the regular gas wells. For those who wish to visit it, the cars will be in waiting at the hotel at 6:30. Those who wish to see the performance, are requested to come promptly, as the heat from the pipe is so tremendous that it hurts the roofs of the houses in the vicinity, and they do not care to keep it lighted for more than a few minutes at a time. Those who go will be able to return in time to take the eight o'clock train for the east.

DR. MOSES: It is perhaps out of order, but just suspend your judgement for a while to enable us to offer a recommendation to the committees that have been appointed by the chair. A committee is supposed to express the feeling of the body from which they are severed for the time. It is rather a concentration of action for the purpose of subsequent general discussion. I would therefore ask these gentlemen of the committee who have been appointed to consider the amendment of Mr. Leggett, to bear in mind

that we have been going along successfully since the founding of this association under one leadership. [Applause]. If we have been successful, it is very largely due to his discretion, and to his continuous government of this body. He now finds the burden a little unbearable at present, and has got restive; and, if I may use such an expression, he has "kicked over the traces" this time. But, we may still want him as a wheel horse; there is no telling. Therefore I would ask that committee to please consider seriously whether it is advisable in any way to hamper us in our re-election of such a man, when the time may come that it shall seem desirable. Death might remove the most able presiding officer; circumstances might cause his resignation; we might feel as if there was a kind of crisis in our affairs; and it would not be possible perhaps, to amend the constitution quickly enough; and it may be necessary for us to have the leadership of our president again. Therefore, without anything that appears like fulsome compliment, or that bears any appearance of flattery (for I regard that as once sat upon by the committee), I think it would be wise to consider very carefully whether we should hamper ourselves at any time when we get a good man in the office, a man who might be pre-eminent in that position, and whom we should not want to get rid of. Another crisis may occur in the history of the association. The very legislative pool that the chairman of our legal committee was going to stir up might require us to have a very strong man in the chair. So I hope that the committee will consider this suggestion, and will excuse my offering it.

I am requested, Mr. President, by F. G. Acheson, the gentleman who was appointed yesterday by the chair as a member of the committee on insulation, to express his thanks to the convention for the honor done him, and he says that he feels that while he is perfectly willing to give us the benefit of his experience in such matters, still the fact of his occupying a position on that committee might be misinterpreted by other gentlemen who are connected like himself with wiring interests. And, therefore, while thanking the association for its action, he respectfully declines the honor of the appointment.

MR. MASON: I move that we accept the resignation of Mr. Acheson; I make this motion as I made the motion yesterday, confirming the action appointing him; I do this in deference to his delicate feeling, which I fully appreciate.

THE PRESIDENT: Ordinarily the appointment of a gentleman upon any committee would be directly in the hands of the president; and the necessity for a resignation would not exist. Mr. Acheson was paid the high compliment of having been elected to a place on this committee by the direct and unanimous vote of the National Electric Light association; and that is a compliment which was never before paid to any gentleman in the history of the association. It is with deepest regret (you will excuse me for speaking from the chair as that was one of the rights I reserved to myself when you made me president in Chicago) that I find the association is now about to lose (because I see the drift of this) the services of a man so eminently capable of acting on that committee, and of giving intelligent and useful information to this association. I hope, although he leaves the committee, he will not deprive us of those services which he is so eminently fitted to give. The question is on accepting the resignation of Mr. Acheson.

The question was put, and the resignation accepted.

THE PRESIDENT: I suggested to the acting president of yesterday afternoon the propriety of having the very important papers which were to be read presented for discussion this morning. We are now through with our business and are ready for the discussion. The papers to be read relate to a subject of more interest perhaps to the members of the association than any subject that has been presented to them for a long time, that is, they relate to the alternating and direct currents. T. C. Smith of Pittsburgh, and Mr. Shallenberger of Pittsburgh, are to present their view of the case from the alternating current side; and Mr. Leggett and Jesse M. Smith of Detroit are to present the other side. The other side covers a whole lot of ground. If there be no objection all of these papers will be read one after the other, and then the discussion can take place intelligently, as you will then have both sides of the question before you. If there is no objection expressed the papers will take that course of procedure.

THE DISTRIBUTION OF ELECTRICITY BY ALTERNATE CURRENTS.

BY T. C. SMITH.

The distribution of electricity by means of alternating currents, though comparatively new in this country, has already reached such an enormous importance that it is with great hesitation that I venture upon it, even though limiting myself to the strictly practical side of the work, dealing with the apparatus as we receive it from the hands of the manufacturer, and leaving out entirely the question of the efficiency of dynamos and converters. It is only the knowledge that the mistakes of those who center upon any new line of business are the rounds of the ladder by which we all attain success that enables me to lay before you some of the conclusions at which I have arrived after several years' experience of varied types of electric lighting, both by the arc, by the direct current incandescent, and the alternate current incandescent.

The subject naturally divides itself into several heads, but I would first say that it appears impossible to lay down any general plan of distribution which would be practicable in all cases. In almost every town a different plan will be required, and this will depend in most cases purely upon local circumstances. Systems that would be admirable for thickly settled and densely populated districts will not be successful in thinly populated and widely scattered ones. I wish it to be understood that whenever I speak in this paper of success and successful systems, I mean successful entirely in a commercial way, and the conditions of this commercial success will vary in every town and district. I will therefore content myself with describing the method which I have found to be most successful in the various districts with which I have had actual experience, and leave it for those who may be called on to design and lay out the lighting of any particular district to judge for themselves which line of action to pursue.

Naturally the first part of my subject is the dynamo, and the station detail. I have tried the small and large dynamo and have concluded that it is a very great point to properly proportion the size of dynamo to the probable size of the station: that is, not to have dynamos of different sizes, but first to determine what the unit shall be, making it as large as possible, and then make your whole apparatus additions to that unit size. This simplifies matters very much, enabling machines to be interchangeable, both as regards their parts and their work, and this I am sure will be admitted by all who have ever had the annoyance of a break-down on an engine or machinery, when perhaps they had standing idle plenty of apparatus, which, from various circumstances, could neither be used itself, nor be robbed to repair the break-down.

I would drive each dynamo by a separate engine, and this for several reasons. By proportioning the engine to the dynamo it will be possible to have the engine running slightly overloaded when the dynamo is doing its utmost during the hours of heavy lighting, and as this extreme load falls off to the lighter hours of running, the engine will be working at its point of best economy, instead of running underloaded, and thereby wasting steam. Thus we use in our station on Virgin Alley dynamos of 2500 lights capacity, each driven by 200 horse power engine. During sixteen hours of the day these dynamos run driving 2,000 lights, and the engines are cutting off at quarter stroke and developing 200 horse power. During the other eight hours, we have driven these dynamos as high as 2,800 lights, during which time the engine was of course overloaded, and was not working to so good an economy; but eight hours of overload is not nearly so wasteful as sixteeen hours of underload. Again, we have had it very forcibly demonstrated more than once that if the engine be only large enough to drive the dynamo with ease, a heavy short circuit on the mains outside will simply pull the engine up or slow it down, without destroying the dynamo, and only those who have seen a nine foot fly-wheel running 250 revolutions per minute on a 200 horse power engine, slowed right down in almost an instant of time, can realize the terrific strain to which everything is subjected in such cases. I would mention right here that the element of time is a very great factor in such circumstances, as in an accident of this kind mischief is often done before the safety catches can melt out. The direct belting of the engine to the dynamo is always to be preferred; shafting is, except under exceptional circumstances, simply a nuisance for incandescent electric light stations, and the economy of one large engine over many small ones has been enormously overrated. For arc light work, where the lights are all lighted and extinguished at certain hours, the large engine is good; but for incandescent work, where the load is absolutely out of the control of the station, it is impossible to steadily run a large engine at anything like its most economical load, whereas with separate engines the machines can be started and stopped the moment that they are needed or are done with. The oil from shafting will always cause more or less grease and dirt.

For central station use, except for very small plants, I should certainly use separately excited dynamos, and should do the exciting from two or more dynamos, each capable of exciting the whole system. In this way, with the station running at its normal, the only regulation required is that obtained by working the single rheostat in the field of the motor, and as we have designed our station at Pittsburgh, this will mean the regulation of 15,000 lights by one six-inch hand wheel.

Of course each dynamo should have its separate field rheostat to make up for any slight difference in speed of engines. The two exciters should be so arranged that they can be run together or separate, or that either can do the whole work, which, of course, is easily accomplished by feeding them into a separate pair of exciter bars on the switch board, and charging the fields of the alternating dynamos from these. The general question as to whether it is better to use separate circuits for separate machines, or to couple them into a general set of 'bus wires, and distribute from them, is too large to be lightly decided, as also is the question as to whether it is best to run separate circuits for separate districts or to run into a general system of high pressure mains outside of the station, feeding into these mains at different points and again distributing from them. I am not prepared to express any preference, but I think that local circumstances will generally decide this question. There seems to me little doubt that in underground systems the net work of high pressure mains would be the best, but for overhead work we have adopted the system of separate circuits from separate dynamos, using a switch board which enables us practically to run any circuit or any number of circuits from any dynamo, and running these dynamos separately and not in multiple arc. In spite of the utmost precautions, the unregenerate telephone and telegraph men are always hauling wires across our high pressure mains and feeders, and while their wires and not ours generally suffer, after hearing the frightful roar that comes from the dynamo that is running the particular circuit so crossed, we always feel relieved to know that only one dynamo is in danger of being thrown out by the slipping off of the belt, for a twenty inch belt is not a pleasant thing to have flying around loose. In case of any trouble, such as fire, a circuit broken down, or anything of that sort, we can pull the switch of that particular circuit, until we can cut out the part affected. The system that I have laid out for use here will of course take a long time to introduce, in view of the fact that we are changing from one system to the other, and have to be governed largely by the location of our lighting, our existing lines, and the possibility of putting up additional pole lines, but it takes in my vision the form of a series of heavy mains down the main streets with cross lines on the cross streets, with switches on the poles, cabling any of the cross streets to be run from the mains on either of the main streets, so that in case of a fire on one of the main streets the section represented by the block in which the fire occurs, can by the pulling of two switches be completely cut off, while the cross streets on either side of the section will enable the lights beyond the fire or broken circuit to be operated, with only the trouble of a slightly larger percentage of loss and the consequent dimming of the lights.

For the main overhead wires, I must harp upon the old string which cannot be struck too often; namely, high insultation. For 100 volt current work, the old standby of "Undertakers" wire will pass; but when it comes to 1,000 volts difference of potential, and 130 or 140 amperes to back it up, one realizes very quickly that nothing is too good to curb this fiery steed. We are still paying the penalty of early ignorance in having many circuits of underwriters wire stretched upon our poles, and I have stood and listened with fear and trembling to the howls of a new dynamo which had only been in operation for a few hours, when we had four short circuits in as many minutes, caused by dead wires falling across these mains on a wet day; while on the other hand I have been gratified beyond expression to see our linemen remove ten or twelve old bare iron "District call" wires which had been hanging all night right across our high pressure high insulation mains, and this during a soaking rain. Especially should the service wires to the converters be of the best insulation, not only for fire, but for protection to life, for while the shock does not kill, even a 100 volt shock may make a man start so as to fall off a ladder, and any death or injury will be credited to the electric current. We have adopted a standard of a separation of three feet between the two wires nearest each other on our cross arms, and do not allow under any circumstances the tapping of service lines directly to these wires. All services must be attached through the medium of a small spreader on the end of the cross arm, which I have no doubt all those present have noticed on the streets.

In some districts where the number of lights in each building is small, we run secondary low pressure mains, and place the converters on the poles, and make our distribution from our secondary mains, but our experience has been that this is not a very satisfactory way of doing. The percentage of loss on those secondary mains, unless the wires are very large and the converters very numerous, either of which is objectionable, causes such a decided variation in the lights as to give grounds for numerous complaints.

The question of the loss on the high pressure feeders and mains is one which I think has not received enough attention. When the alternating system was first introduced, so much was said about the extreme smallness of the wire required that a great many of the arc light men throughout the country who had been accustomed to congratulate themselves on the fact that No. 6 wire was big enough for a 20 mile circuit immediately jumped to the conclusion that because it was a high tension current, No. 6 wire was big enough for all purposes; and consequently more than one case of dreadful grief has arisen. I have laid out our circuits on a certain fixed plan, which is that each circuit shall be laid out for 1,300 lights (that being the size of unit which we at first adopted) and made them of sizes to carry these 1,300 lights with a loss of not more than 2 per cent. with the whole load on. By having feeders large enough for this, we prevent any noticeable differences in candle power from one end of the circuit to the other, and should we be even compelled to run a light circuit and a loaded one on the same machine, the increase in the one or the decrease in the other would not be injurious. Of course we try to so arrange our circuits so that the load shall vary about the same on each, but the suddenness with which storms creep up in Pittsburgh makes our load very uncertain and erratic. We have run for three days and nights with only a little more than half of the machinery in operation, and then from Monday night to Friday morning have had to run every incandescent machine in the station under a load that fairly staggered it.

I now come to the question of the placing of the converters, and for this I think that you may safely lay down the general rule that wherever you are simply carrying current, do it at high pressure, and keep your low pressure for the purely local distribution. With proper precautions, I do not see that there is any real danger in carrying the high pressure wires into and through the building. If a thousand volt current from a central station is not to be allowed in a building on account of its dangers, then, every arc light plant, whether from central station or an isolated plant in the building, must be condemned for the same reason. Of course, the cases where two wires of an arc circuit with a difference of a potential of 1,000 volts are run close together, are not nearly so frequent as must be the case where there is constant difference of potential of 1,000 volts in the alternating system, and again, of course we have the fact that the direct current on arc circuits is generally not more than 20 amperes, while, as I have remarked before, our alternating circuits run as high as 130 amperes; but the fact that one is a direct, and the other an alternating current, largely makes up for this difference. With all due respect for the many gentlemen who have discussed so learnedly of the deadly alternating current, and on the frightful results therefrom, and whose experience with the alternating system is mostly confined to the magneto bell or induction coil, I must maintain that the alternating current, while it is in mild doses of from one hundred to two or three hundred volts intensely more disagreeable than the direct current of the same voltage, when it comes to 1,000 volts,

or more, it is very much less dangerous to life. I make this statement with the more confidence as I have tried them both, and we have in our station here not one, but half a dozen cases, where our linemen and dynamo men have received the full 1,000 volts, generally being pretty badly burned at the point of contact, but experiencing no ill after effects, while, whenever any of our men receive a shock from one of our arc machines, they are nearly always sick for a day after. This very fact of the alternating current being more disagreeable adds to its safety, as the men are disinclined to work on the wires, even when there is only a slight leak, where, with the direct current, they will often take much greater risks. In carrying our high pressure wires through the buildings, we have adopted the invariable rule that they must be carried on porcelain insulators, and the wires themselves waterproof in all cases. We do not allow them to be run in moulding, but where the wires are to be concealed or protected a casing is run around the wires, outside of the porcelain insulators. Hard rubber must always be used for floors and walls. The converters are all placed with porcelain knobs behind them, giving an air space of two inches between them and the wall, and we prefer in all cases to put them against brick, rather than against wood or plaster. I understand that in some districts the use of converters inside buildings has been forbidden, but I think that this position is a most unjust and untenable one. The only argument that can be brought against their being placed inside is the danger to life or of fire For the first, the converter is well insulated, and is placed high up, out of reach, and a most potent argument, though one, I am sorry to say, often refused recognition, it is not placed there to be handled. As regards the danger from fire, all the converters with which I have had any experience are boxed up completely in iron cases, the only opening in which is a small one at the bottom, for ventilation. They cannot possibly get hotter than the melting point of lead for the simple reason that if they should the fuses would blow out and cut them out of the circuit, and any one who has performed the old experiment of melting lead in a piece of paper can easily see that this heat is not liable to set anything on fire; and even should the converter burn out no flame can escape from it to set fire to anything, however inflammable. If the converter is to be banished from buildings on account of danger from fire, then every stove, high pressure steam pipe, and, for that matter, every gas jet must also be banished.

In a Chinese fire cracker lately published I find the statement that Inspector McDevitt has relegated to the cellar all converters, and that he says that in the first case of explosion or fire from them they will have to go to the street. Now, as vice president of the company owning these converters, I have simply to say that this is not so, and that these converters are placed all through the buildings, wherever we may desire to have them, and only three or four are in cellars. Moreover, so far from Mr. McDevitt making any such statement, he has steadily refused, even under the most urgent solicitation of the Chinese gentlemen, to make any such restriction, but has very properly stated that until an explosion or fire occurred, he can take no such action. I speak of the publication as a "fire cracker" for three reasons—first, because it is red; second, it is chiefly noise; thirdly, a good many crackers are only fizzles.

In regard to the liability to burn out and the dangers therefrom, I can only say that out of over 600 converters of all sizes, from 5 to 50 lights each, in an experience extending over twelve months of constant service night and day without any stop, we have had but three actual cases of burning out, two of these being five-light converters and one being a fifty-light converter. The two five-light converters were simply slowly roasted from overloading, until, finally, the insulation on the primaries were charred through, when the fuses blew out instantly and all was over. In one case the customer had been attracted by the converter singing, and was standing looking at it when his lights suddenly went out, and he had to go into a neighbor's store to ascertain whether the trouble was in his lights only or with the main circuit. The fifty-light converter suffered in the same way, having nobly endeavored for some two days to run 120 lights. It was one of three on a section of secondary mains, and the lineman who had been sent out to examine them, owing to complaint to us of poor light, reported that two of them were all right, as they were cold, but that one of them was bad, as it was very hot, and preparations were being made to change this converter, when a message was received from one of our customers that the "stove on the pole" in front of his place was smoking. Investigation showed that both plugs in the other two converters were blown, and the only reason that this one had not followed suit was the fact that some ingenious gentleman had made them of copper. We have had three cases of defective converters; that is, converters with a wire broken inside, or short-circuited, so that the moment the current was put into them, they would blow out all the fuses, and if new fuses were put in, they would again immediately blow, but the men in these cases of course immediately returned them to the shop for examination. Out of the 600 converters, we have actually had to remove or repair 1 per cent. in actual service, and I submit that on a total converter capacity of 17,000 lights, this is a very good proof that these converters are well made and not dangerous.

In all of our experience, we have not had one single case of connection between the primary and secondary, or the primary and the shell of the converter, even in the case of the burned out converters, and we had just a few days ago the first case of a connection between the secondary and the shell of the converter, and this last was found upon examination. We started in with the idea that it was better in cases where we had, from the number of the lights in a building, to use more than one converter to bank them; that is to say, connect all the primaries and all the secondaries in multiple, and distribute from this bus wire, but two or three peculiar experiences have led us to change our plans, and never to do so if it can be easily avoided. We had two or three unfortunate cases where one converter of a bank for some unknown reason would blow its plug, thus overloading the others, then perhaps another would give way, and thereafter it was a race as to which would blow its plugs the quickest. It is not calculated to make one feel comfortable to have 400 lights in a theater go out at once, just as the curtain was about four feet from the stage, in the beginning of the third act, yet this was our experience last Christmas day. We had the converters fused up and running in half an hour, but next day the same thing occurred, though the gas man seeing the lights dim down was quick enough in shutting off his different circuits to stop three or four converters, which gave lights enough to pull through. We have cut this building up, and each converter now carries its own load with the result, we have detected one of them which for some reason unknown always tried to do more than its share of the work, but while we have marked it, we have not troubled to change it, as, working singly, it does its work well. We have had another case of the same kind in another bank of converters, which have also since been separated, when we found the trouble arose from a poor connection which heated up the fuse to melting point; yet, as we have in the City Hall two banks of thirteen ten-light converters each, and in the Union Station a bank of twenty five ten light converters and eight twenty-light converters, from which have never had the current off for nearly three months, and not a single converter blew its fuses, we cannot say that this result would always or even generally obtain; but as the object of banking is primarily to prevent the total extinction in case of one converter going out, and as this is better attained by the judicious running of the secondary circuits, we prefer keeping the converters separated.

For the secondary wiring in the buildings we need lay down no laws. The rules governing this are too well known to need any repetition. One advantage of the alternating system, which was first brought to my attention by one of our wiremen, is the fact that wires carrying the alternating system do not blacken the surface on which they run. We have in our station circuits of direct and alternating currents side by side put up at the same time, on a ceiling painted in very light colors, and which have been burning the same number of hours. The paint under the direct current wires is very dirty, in the usual style, and the wires themselves are covered with black deposit, while the alternating current wires, and the ceiling on which they lie, are as clean as when put up.

There yet remains one point on which I wish to say a few words, and it is a subject of the greatest importance. Now that the alternating current distribution is a pronounced success, there is no reason why the places of all others where incandescent light is most desirable, merely in residences, should not enjoy the advantages and improvements from which they have been hitherto debarred by their distance from the usual center of distribution, and it is when we bring electricity into the dwelling-house, where it will be daily and hourly needed and handled by women and children that we realize how absolutely necessary it is that we use anything and everything that can tend to make safe its introduction and manipulation. Of course the first and second of these are, good insulation, better insulation and best insulation, but besides this, there are other points to be considered, and one that seems to be worthy of very careful consideration, and the fullest discussion, is that which has been more than once suggested, namely: the making of permanent ground connections with the secondary wires. The object of this is, of course, that should a leak occur at any point between the primary and secondary, the current, being already grounded, will render it impossible for any one to receive a shock by touching the secondary and at the same time making an earth connection. When I first considered this question I said in my haste that this was not a proper course of action, as it simply provoked a ground at some other point and seeing the careful insulation of the converters we use, I could not see any danger of a leak across. I have considered and heard some discussion both pro and con, and for this purpose I should like to hear the most bitter partisans on either side, that we may get from them every little weakness on either side of the question brought out.

In a paper like this it is impossible to do more than to give the merest sketch of the subject, but I trust that what I have said may be the means of inviting discussion and inquiry, for it is only by this means that we can arrive at the true facts in any case, and, as we all know, the electric light industry has suffered more than tongue can tell from the general ignorance of its dangers and requirements, which hindered and injured its early introduction into this country, and which led to the spending of so much good money on plants and wires which were not merely insufficient, but absolutely dangerous. Now that we have taken, as it were, a new departure and entered into a new era of progress, let us not fall into the same errors which marred the early history of our business, but strive with might and main, by discussion and interchange of experience to make each new installation another stride towards perfection in what I think is undoubtedly the greatest achievement of the age—the distribution of electricity by alternate currents.

The Energy of Alternating Currents.

BY O. B. SHALLENBERGER.

The adoption of the alternating current for electric lighting has introduced a number of questions in regard to its measurement which have an important practical bearing, since they involve the subject of the relative efficiency of the direct and alternating systems; and for this reason, perhaps, a few words on the subject may not be amiss. It is not proposed to enter into a mathematical discussion, but rather to offer a few illustrations and examples which will assist in a general understanding of the subject, and at the same time prove the uncertainty of the well known rules for direct currents, when generally applied to alternating currents. Under certain well defined conditions such methods may be employed without sensible error, and fortunately for the electric lighting industry, these conditions are naturally present in the exact kind of apparatus necessary for the simple and economical distribution of the alternating current.

In estimating the amount of energy expended in a circuit traversed by a direct or continuous current we are accustomed to base the calculation on measurements of the difference of potential between the two points of the circuit in question, and, at the same time, the current traversing that circuit. The product of these two quantities, as is well known, gives a correct measure of the energy of the circuit expressed in watts. This method may or may not be applicable to alternating currents, the distinction depending upon the presence or absence of self-induction in the circuit. In the case of a straight copper wire going out from the source of current and turned back on itself in close proximity, it may be assumed that self-induction is practically absent, and hence no sensible error would be involved in taking the product of the difference of potential between any two points, as measured on a Cardew voltmeter, and the current traversing that portion of the circuit as determined by a Siemens dynamometer, and then using these two factors in the product which represents the amount of the work done. This would give a correct result; but the introduction of a coil of wire wound in one direction, especially when it surrounds an iron core greatly modifies the conditions, and causes an error, the amount of which is dependent on the form and size of the coil. The reason for this is that the additional element of self-induction has been introduced, with consequent retardation of the phases of current. This simply means that, as the difference of potential alternately rises and falls and reverses its polarity, the corresponding fluctuations of current do not occur at corresponding instances of time. The want of synchronism may be of any amount between zero and a quarter of a complete wave length. When there is no self-induction present in the circuit, there is no displacement, but a departure from this relative position may be produced by introducing self-induction into the circuit, and to a point which may theoretically cause the waves of the current to lag a quarter of one complete alternation behind the waves of the electromotive force, although it is impossible to realize this amount in practice.

Let us inquire now what is the effect of this displacement on the amount of energy expended in the circuit. As a preliminary step it will be well to examine the case of a secondary battery which is being charged from a suitable direct current generator. Suppose first, that current is supplied from the generator with a sufficient electromotive force to overcome the counter electromotive force of the cells, and produce a certain flow of current. We may introduce into the circuit a suitable ammeter to determine its amount, and connect across the circuit a voltmeter, and by the product of the indications of these two instruments we obtain a result which shows the expenditure of energy at that time. But if, later in the process of charging, the speed of the generator is reduced to such a point that the counter electromotive force of the battery is sufficient to overcome the electromotive force of the generator, and cause a flow of current in the opposite direction, it is well understood that the battery would no longer be charging, but would be running the dynamo as a motor, and consequently expending energy upon it. If the resistances of the armature and battery are low, the readings of the voltmeter and the ammeter might be exactly the same as in the former case, and the product of these two factors would of course show the same amount of work done. In the absence of any other information than the readings of these instruments, it would be impossible to judge whether work was being done by the generator on the battery or by the battery on the generator. Another element requires consideration, and that is the direction of the current as related to the difference of potential across the circuit. Referring to diagram 1 [indicating] a generator is shown at G supplying current to charge a battery at L. Let it be assumed that the electromotive force of the generator is in such a direction as to make the upper conductor positive, with relation to the lower. Calling this a positive electromotive force, a current in the direction of the full arrow would be positive, and one in the direction of the dotted arrow would be negative. Whenever the generator is doing work on the battery, the current flows from the positive to the negative conductor through the battery, or in the direction in which the generator tends to deliver the current. If we had called the electromotive force of the generator negative, this would be a negative current. We can assume either, but in each case the current and electromotive force have the same sign. When, however, the electromotive force of the generator falls sufficiently to allow that of the battery to overcome it, and send a current in the opposite direction, as shown by the dotted arrow, the conditions are reversed; that is, the battery is doing work on the generator and driving it as a motor, but without the polarity of the external circuit being charged. We now have a positive electromotive force, a negative current in the battery, and work done by the battery on the rest of the circuit.

The foregoing is only an illustration of the general law that when the difference of potential between two points on an electrical circuit is of the same sign as the current traversing it, work is being expended on that portion of the circuit; and conversely, if there are opposite signs, work is being restored by that part of the circuit. It is therefore necessary to know the relative polarities of the current and electromotive force as well as their amounts, in order to have a complete knowledge of the energy of a circuit. The same thing is true of an alternating current, that is,

we must know whether the instantaneous values of electromotive force and current have the same sign, as well as the values themselves; and this can only be the case where no self-induction is present, or in the practically equivalent case in which the self-induction is so nearly neutralized as to be of no relative importance.

Referring now to diagram 2, [indicating] there are shown two curves in the upper figure, E and C. E represents the the phase of electromotive force of an alternating generator, and C the corresponding current through a circuit possessing a certain amount of self induction. Distances along the horizontal line are taken, as usual, to represent successive periods of time, and the relative amounts of current or electromotive force are represented by the vertical distance above or below this line, those above being called positive, and those below negative. It will be seen on inspection of the figure, that at the instant shown at 1, the electromotive force is zero, while at the same time the current has a considerable negative value. Again at the point 2 the current falls to zero, while the electromotive force has risen to the amount shown by the vertical line at 2. At 3 we have an instant at which the current and electromotive force are of opposite sign. Here we have three distinct cases, in the first two of which no work is being done, and in the third work is being done by the circuit on the generator; but in each case an effect would be produced on the instruments used for the measurements of electromotive force and current. In fact, taking independent continuous measurements of the electromotive force and current, it is quite evident that the same results would be obtained without regard to the time relation of the phases, so long as the form of each remained unchanged, and for this reason the result would be the same from such measurements whether the curves were coincident in time, and the current curve occupied the same space as the curve E, or were displaced as shown in the diagram. In the former case, as there is no displacement of phase, the products of the current and electromotive force at each instant would be positive; that is, work would be done at each instant upon the external circuit except when passing through the valves at zero.

The effect of the displacement of the current phase is shown in the lower figure, where a curve is drawn to show the phase of work done at each instant of time when the lag of the current phase is of the amount here represented. At 1 work is being done, since the product of E and C contains a zero factor. Between 1 and 2 we have work done by the coil, since the electromotive force is positive at the same time that the current is negative. Then we have a period in which work is expended by the generator; and then at 3 again, work is restored by the circuit to the generator. By still further displacing the current phase the amount of work restored to the generator may be greatly increased. The example I have taken, a retardation of about one sixth of the phase length, is a very moderate one, and easily realized in practice, and yet the amount of energy restored to the circuit in the work done by the coil is nearly one-fourth of the apparent amount of energy expended, as shown by the product of current electromotive force. The diagrams are not intended to show the exact forms of current phase, or of the phase work done, but they are sufficiently near average conditions for purposes of illustration.

A retardation of one-fifth of the phase restores about one-third of apparent energy to the circuit, and beyond this point, the proportion restored increases in a high ratio. The actual work done can never be more than the product of the current and electromotive force and may easily be only a small fraction of that amount.

To show that this retardation is not an imaginary thing, but may have a very decided influence on actual measurements, I will describe two experiments which show phenomena that can be accounted for in no other way, or at least, cannot be explained by the ordinary rules of direct current measurement. An experiment by the writer similar to the second of these was described by Mr. Stanley, in a paper before the New York Society of Engineers some weeks ago, and is still another example of the same phenomena. In Figure 3 two conductors A and B, are shown [referring to diagram] between which an alternating difference of potentials of 100 volts is maintained, and indicated on the Cardew voltmeter V. Between these two conductors a third C, is placed, and two Cardew voltmeters, V_1 and V_2 are connected across the two circuits, and show by the sum of their readings the difference of potential between A and B. They should, under ordinary conditions agree with the reading of the one at V. Between A and C is connected an incandescent lamp L, and between C and B through a switch, the circuit may be closed either through the lamp L_2 or through a coil of wire S, which surrounds a soft iron core. With the connections as shown in the diagram; that is, with the switch connected to the lamp L_2, a perfect balance is obtained, and by adjusting the difference of a potential between A and B to 100 volts, we obtain readings of 50 volts on each of the voltmeters V_1 and V_2. If, however, the switch be transferred to the point which connects it with the coil, a somewhat remarkable effect is observed. The readings of the voltmeters at V and V_1, remain constant, since the coil has been so proportioned by trial as to exactly replace the lamp L_1 and maintain L_2 at exactly the same degree of luminosity; but the voltmeter, V_2, instead of remaining constant in its indication, as might have been supposed, increases its indication to 80 volts, so that we have our choice, so to speak, of two measures of the difference of potential between the conductors A and B. These are of such large cross-section as to be of sensibly the same difference of potential throughout their length. Measuring at V we have 100 volts as before, but at V_1 and V_2 we have the sum of fifty and eighty or 130 volts. It is quite evident that there is some condition present, entirely remote from any which could be produced by the action of direct current; for it is absurd to suppose that at the same instant of time we can have two separate values for the difference of potential between the same two points. The natural inference seems that these measurements show in reality only the average of effects which occur successively, although they appear to be simultaneous.

When an impulse from the generator occurs, current flows through V_1 and V_2 instantaneously, and this would give a reading of 50 volts on each if acting alone; but the same impulse, acting through the coil S produces a current which, owing to the self-induction of the coil, lags behind the electromotive force, and therefore the coil must restore work to the circuit at some point in the phase. This work is partly expended in the voltmeter connected to the coil and for this reason it gives a higher reading than the other. Figure 4 shows a second arrangement in which the current is indicated by a Siemens dynamometer D, and the difference of potential is maintained constant by the electrometer E. The current may be adjusted to the proper amount by means of the resistance R, introduced in the circuit. An incandescent lamp $4'$, is also placed in the circuit in series with the dynamometer, to indicate to the eye any fluctuations in the current. At L a similar lamp is placed, and around its terminals is shunted a properly proportioned coil S, surrounding an iron core. A Cardew voltmeter V, is connected at the same points to show the difference of potential. With the switch disclosed the normal current passes through the lamp L, and a difference of potential of 50 volts is shown on the voltmeter V. The dynamometer shows one and six-tenths amperes to be passing through the circuit, and the electrometer indicates 1,000 volts. On opening the switch d, a slight increase of current is shown by the dynamometer D, while the difference of potential at E is constant. The only change in the arrangement of the circuit is that the current instead of passing through the lamp L, and the coil in parallel, now passes through the coil alone, and yet instead of 50 volts the voltmeter now indicates 148 volts; so that we apparently have 98 volts more in the circuit without noticeably changing the difference of the potential at the terminals, and without sensibly changing the current; or, to look at it in another way, we have under a constant potential at the extremities of the circuit, introduced an apparent resistance, and at the same time increased the current traversing the circuit. We have here a case similar to the former one, and as the explanation is much the same, it need not be repeated.

The question naturally arises, what influence does this new element of self-induction have upon the possibilities of practical measurements of the alternating current in commercial work? As was stated in the beginning, the practical effect is almost negligible, for there are two cases in which the time element enters to such a limited extent, if at all, that the measurements may be made with perfect success in precisely the same way as if direct currents were employed.

These are, first, the measurement of current through an incandescent lamp supplied by an alternating current directly from the generator; and second, the current supplied to lamps through the medium of converters which are far below saturation and carrying a fair proportion of their full normal load. There is a third case, however, which arises in practical work, in which the central station instruments give a somewhat false notion of the actual energy being transferred to the circuits, and this is the one in which a large number of converters are connected to the primary circuit but with the secondaries open. In this case the effect of self-induction is at its maximum, and there is, consequently, a lag in the circuit, which, in a well constructed converter, approaches the theoretical limit of a quarter phase; at which point no energy would be consumed, while at the same time a considerable reading might be shown on the current instruments. This apparent difficulty is not a real one, since even the full amount of current shown by the ammeter only constitutes a small percentage of the total output of the plant, and may be practically neglected. Even a small number of lamps in service distributed among the converters greatly reduces this error, and for this reason, even while running with a light load, the ammeter at the central station very nearly corresponds to the number of lights in the service: while at full load the reading is as accurate as if the current passed directly from the generator to the lamps.

It ought to be evident, however, from what has been shown, that the method which has been sometimes adopted of turning off all the lamps from the secondary circuit, leaving the primary connected to the generator, to show the amount of energy lost in conversion, is apt to give very misleading results unless the proper correction for retardation is applied.

The best proof of economy in the use of converters is that a test of the power expended in running a dynamo at its normal electromotive force, with its circuit closed through the primary coils of its full complement of converters is the same as when the primary circuit is entirely open, within the ordinary limits of error of measurement.

The Undergrounding of Electric Arc Light Wires.

BY WELLS W. LEGGETT.

This topic is one of absorbing interest at the present time. Municipal and legislative authority seeks to compel the burying of all the wires without discrimination, and to cast upon the parties interested the burden of finding a practical means to accomplish the end. The progress of invention in science and art records infallibly the cotemporaneous public demand. This demand discloses a necessity and inventive ingenuity suggests the remedy.

Starting from this standpoint we find public wiring began with the telegraph. In 1753 was evolved an electric telegraph wherein insulated wires were to be trained on poles. Le Lomond, in 1787, Betencourt in the same year; Riezen in 1794; Cavello in 1795; Salva in 1796; Sommering in 1809; Coxe in 1810 and Sharp in 1813, all had telegraphs, employing from one to twenty-six wires, trained on poles. At this stage, however, the interesting experiment to which the world lent a helping hand developed signs of commercial utility, and value. Man's cupidity and selfishness, at once antagonizes what he cannot share, and we find the public arrayed in opposition to the use of the highways. Inventive ingenuity came to the rescue and in 1816 Ronalds erected and used a telegraph in which some of his wires were placed on poles and some were buried in the ground. Tribavillet followed in 1828 with a system employing underground wires, and when Professor Morse, in 1832, brought out his system, he proposed connecting Washington with Baltimore, a distance of 44 miles. To his mind the wire should be insulated and laid in a lead tube in the ground. He constructed his line with great care and a large expense; but only a few miles had been laid when the gradual escape from the line proved his scheme impracticable. He was about to abandon the undertaking when one of his coadjutors, Dr. Page, of the patent office, or Professor Henry, of the Smithsonian institute said to him, "Take your wire from the ground and train it on poles." The advice was followed and success achieved. Here then in the incipiency of public wiring is the first recorded failure coupled with its remedy, "Take the wires from the ground and put them on poles."

With underground telegraph and telephone wires the electrical difficulties to overcome are much the same. Moisture must be excluded from the wires. Insulation must be good and induction must be reduced to the minimum, especially between adjacent lines. In both, however, leakage from the lines due to imperfect insulation may be compensated for within the limits by additional force. This force acts like a pump sending water through a leaky pipe—the water may all escape before reaching the discharge end—but with a more powerful pump, while increased pressure will cause greater escape through leakage, one may succeed in discharging a limited quantity through the end of the pipe and so accomplish the purpose sought. For this reason underground telegraph and telephone wires may be operated with a measure of success.

In most of our cities all telegraph wires might be led to a certain point from which the wires of all systems could by one underground conduit be led to a central station or stations, and thence back through the same circuit, and where the wires are numerous, this plan might warrant the expense. With telephone companies, whose subscribers are in all parts of the city, the requirements that each wire should be conveyed underground would involve an outlay for conduits wholly prohibitive.

For direct service incandescent lighting the required conductors are so large that to train them upon poles or to train an equivalent capacity in smaller wires on poles would involve outlay and annoyance exceeding that required to underground the conductors. So, again, the resistance on the conductors to the flow of the current is exceedingly slight; it might be compared to the pouring of water from a pitcher through a six inch pipe, its course of least resistance lies right forward through the pipe, and there is little tendency for it to seek an exit through any other restricted channel In comparison with it the arc light current might be likened to a large hose with a small nozzle, through which water is being forced with a powerful pump; the tension is very great, and if so much as a pin hole exists in the hose, water will squirt therefrom, and quickly enlarge the orifice to a fatal rent. From the fact, therefore, that telegraph and telephone and incandescent electric light wires may be trained underground with success, by no means does it follow that the same is true of arc light wires.

It is an undoubted fact that to successfully underground electric arc light wires, involves simply and solely a question of expense. But expense may be the very essence of the inquiry, for if the expense is out of proportion to the revenue that can be derived from the service, expense alone prohibits the outlay and determines it to be impracticable. Expenditure of money is alone required to tunnel the Dover Straits, and, yet French and English capitalists have pronounced it wholly impracticable, as the returns could not warrant the investment. So it is with electric arc light wires; an efficient system, so far as inventive ingenuity has yet presented any plan, involves an expenditure wholly prohibitive, and for that reason alone is impracticable.

All substances are conductors, as copper, iron, rubber, glass, dry air. Some substances are such poor conductors that, in comparison with those that are better, we call them non-conductors. We use these poor or non-conductors, such as rubber, glass, paraffine, wood and dry air, as insulators, but we find dry air to be our most perfect insulator. Dry air is a better insulator than rubber. If, therefore, in dry air two rubber covered wires cross in close proximity to each other, the induction is greater between them than would be the case if both wires were bare. But air is usually laden with moisture, and water, charged as it is with mineral salts and acids of the atmosphere, is a good conductor. We therefore coat our line wires with an insulating material, to shield them from direct contact with moist surfaces or other good conductors, and so reduce in amount the current, which varies in direct proportion to the conducting property of the intermediate medium.

When our insulated wires are trained on poles, we have at the rate of 30 poles to the mile, thirty points at which a small amount of current may and always does slip to the ground. Now let us put an insulated cable in a conduit in the ground. The conditions are all changed in the most aggravating manner. Instead of comparatively dry air, the air is clammy and heavily laden with moisture; instead of a mass of surrounding air as on the poles, the envelope of air is, at first but an inch more or less in thickness; instead of resting at 30 points in a mile on glass supports, connected to dry non-conducting wooden poles to make the passage to the ground as much obstructed as possible, the line touches the conduit at say two or three points in the space of every foot, or say, at ten thousand points in a mile, and the conduit itself, a much better conductor than glass or dry wood is all that separates it from the moist earth. The bearings at which the current may slip away have been multiplied from thirty contacts to ten thousand contacts per mile while the conducting of the medium at each point has been greatly exhausted. A regulated arched subway has been suggested, which approaches most nearly to a successful plan but only a state or city could stand the necessary outlay. A subway of this character, four feet wide

and eight feet high for Chestnut street alone, in Philadelphia, it was estimated, would cost the city $1,500,000. After completion such a subway would have to be supplied with forced ventilation to keep it dry. If then the insulated wires could be supported so as to touch at but thirty points to the mile, the conditions of extended wire training on poles would be fairly approximated.

The question is frequently asked, if telephone and telegraph wires can be undergrounded, why cannot arc wires be disposed of in the same way. The reason is plain, seepage or escape can be supplied in the former by an additional battery power but an arc light generator is a queer specimen of mechanics. It starts a mild current, and this passing back around its field magnets builds them up; the increased magnetism induces greater impulses in the bobbins of the armature; the current thus increased continues to pass through the line and back around the field magnets until the current has reached its maximum. It is therefore apparent that anything which seeps the current from the line, not only steals the quantity which has escaped but prevents justs so much current from passing back around the field magnets and to that extent robs the machine of its capacity to generate a current. These machines are capable of taking care of the same amount of loss at the insulators in the pole and line system, but when this is multiplied many times as in an underground conduit it is so robbed of its power to recuperate that the resulting lights are necessarily reduced in number and are weakly and sickly.

Operations looking to the undergrounding of arc-light wires have been prosecuted on a large scale at New York, Brooklyn, Chicago, Philadelphia and Washington. Notwithstanding all reports to the contrary, I find that at New York although the subway commission has expended vast sums of money and has succeeded in burying certain telephone and telegraph wires, no arc light line has up to this time been buried in New York City, and this is fully corroborated by the report of the board of electrical control, of January 6, 1888.

At Brooklyn, New York, the board of commissioners of electrical subways instituted a thorough investigation of this subject in 1886 and in its report of December 30th, 1886, says: "With regard to electric light conductors this board has found no device which would with certainty, in its opinion, enable the wires carrying arc light currents to be safely and successfully operated in the same conduit with telephone and telegraph conductors without disturbance or injury to the latter. But the board desires to say, emphatically, that those fluent critics who talk of putting electric light conductors underground, but make no distinction between arc lights of different systems, are ignorant of the alphabet of the subject." The president of the board visited all the principal cities in Great Britain and Europe; he found no arc light wires underground and although a few years since such wires were trained in the Paris sewers, they have been removed and no arc light wires are now allowed therein.

The Brooklyn commission made another report, Dec. 15, 1887, and on this topic say: "As was full explained in the last report, the subject of underground conduits for arc currents is the one which presents the most numerous and novel difficulties. Since it has been impossible for Brooklyn to take the lead in the experimental solution of these, the only remaining course was to watch carefully the progress of experiments in other cities. This has been done, both by correspondence and by personal visits of members of the board The principal cities in which experiments of this kind have been in progress are New York, Chicago, Philadelphia, Baltimore and Washington. In one or another of these, several systems which were regarded with favor a year ago, have since developed defects or even come to entire failure. It cannot be said that any system has yet been completely proven to be permanently satisfactory. There are one or two however which promise well and this board awaits with attentive interest their further trial; though for the cause specified they failed to co-operate in the experimental investigation of the different and delicate questions involved." There are no arc light wires underground up to this time in Brooklyn.

At Washington in 1884, cables were laid in F St., from 9th to 15th. In a few months, it was necessary to dig up a few of the same. Later, there was much more trouble and it was all taken up and relaid. About one year after the first laying, it was wholly abandoned because they could not make it work. In 1885, they laid cables on Pennsylvania avenue, from 9th to First street, and imported an expert from Antwerp to lay them. Twelve cables were laid in solid cement and no expense was spared to insure success. They proved an utter failure. The avenue was dug up many times. The wires were in Sept. 1887, mostly out of service and the remainder were in such bad shape that they would require constant repairing or have to be abandoned.

An officer of the Washington Company writes me under date of Sept. 12, 1887: "We have many committees coming here to see what we have accomplished as they have heard that we have met with great success and so forth. We will say to you that our experience, after the outlay of many thousands of dollars, is this: Have nothing to do with underground cables for arc lighting if you can possibly avoid it. Many will tell you that it is perfectly practicable; look out for such persons; they are probably interested directly or indirectly in cables. There is a big lobby in that branch of business. There is no city or town in the world where a cable has been made to work two years that has been subjected to 2000 volts of pressure." This Washington Company is using lead covered cables with success for incandescent work; but as to the undergrounding of arc light wires, confirmed as late as Feb. 7, 1888, they report that out of 14 miles of arc light cable, in fourteen different circuits, all have proved total failures, and have been abandoned except a very small amount

At Philadelphia elaborate experiments have been prosecuted. All kinds of cables have been employed and a great variety of conduits, but great trouble has been experienced. The systems largely employed were such as had ducts through which the cables were drawn. In most cases the insulating compound rapidly deteriorated and became useless. In others it would be rotted and become water soaked. When lead covered cables were used in conduits where creosote was employed, the effect was to rapidly oxidize the lead covering and disintegrate it. It was found that gas could not be kept from the ducts although apparently gas tight, and many explosions followed. Recourse was then had to ventilation by lamp posts but the trouble was not remedied. After several explosions in one system, in which persons and property were injured, a power fan was adjusted to force air through the conduit as it was deemed a better plan than to draw the air through, as by the latter course gas might be drawn in simultaneously. When shortly afterwards the lighting company was congratulating itself that it had overcome the difficulty a tremendous explosion ensued extending for a long distance, ripping up the street, and breaking a large plate glass window, so that the entire system of lights had to be abandoned. It was some six months ago determined by the manager that as a result of experience no conduit would suffice for arc light wires in which there were open ducts, and that success lay in the employment of lead covered cables buried solid. This plan suggested by the city electricians was tried and success seemed assured, but they now report the experiment unsuccessful. The section buried is not great, but three bad grounds have recently developed. Two were repaired, but the third necessitated the temporary cutting out of a part of the line and the training of wires on poles until the earth might thaw and access might be had to the wires. The united companies of Philadelphia are at a loss what to try next.

At this point I would note that these demands for a system for arc light wires have greatly stimulated inventive ingenuity, but yet without success. Out of 72 patents that have been issued in this line, 53 of them have emanated from Philadelphia, New York, Boston, Brooklyn, Wilmington, Camden, and Washington, all in the immediate vicinity of the places where the operations were conducted. The others were mostly from the vicinity of Chicago. Now as to Chicago—much has been said of its system, but a visit to the city satisfied me that its electric arc light industry was being strangled. A few blocks in the immediate heart of the city were using electric light very lavishly, but the area lighted is scarcely a half mile square. This small area is served from no less than nine separate plants, formerly belonging to as many companies, but now consolidated into one. A letter under date of Sept. 20th, from an officer of the Consolidated company, explains the situation there. He says, "We have had an enormous amount of trouble with our underground arc light circuits, averaging, I should say, for the last three months, one burn-out every day. The expense of reconstruction and the losses in rebates have been enormous and the annoyance to our customers is more damaging still. Commencing in April last we bought out some more arc light plants in Chicago, and have proceeded to concentrate them into four main stations, burning about 1,100 lights. Their owners had all been using underground conductors composed for the most part of okonite, kerite, Callender and underwriters' wire. Everyone of these insulators has failed constantly. The only thing that has held up at all is lead covered cable and we have been driven to the great expense of taking out every foot of the old constructions and of substituting lead covered cables throughout. This work is not yet done. Our people are confident that a large business awaits us here but its development will depend entirely upon device. These lead circuits may fail much sooner than is anticipated, and it is almost certain that we shall be compelled to reduce the number of lights upon a circuit, a very difficult matter in a city like Chicago. Our conduit space is already filled along the main routes and additional conduits will be necessary. The constant tearing up of the pavements for all kinds of purposes makes our street department very unwilling to grant permits for laying additional conduits and several times they have refused altogether. I would say here that arc light business in Chicago has developed entirely since the passage of the underground ordinance of 1881. The result has been the multiplication of small isolated plants and the formation of the nine small central station plants bought out by this company. None of these plants made any money. It was impossible for them to do so, operating underground and upon so small a scale. No streets have ever been lighted by electricity here, in fact the whole industry is in a very backward condition and is likely to remain so except in the most densely crowded portion of the city, unless some arrangement can be had with the city authorities for overhead wires. The city is trying an experiment of its own in lighting the Chicago river, which will, I am confident, demonstrate the truth of the foregoing statement; and in the course of a year I hope that our city fathers will permit overhead lines, in many places where public convenience demands electric lights while underground construction would forbid it."

At Milwaukee, Wisconsin, three systems have been tried and abandoned, among them, tarred iron pipe and grooved wood. A fourth, consisting of tiled conduits with a heavy insulated but not lead covered cable has recently been introduced and is now being tested. The company doubts whether it will stand the trying spring season.

At Detroit, the Thomson-Houston Co. employed a cable of the most extensive and approved character in the Dorsett conduit, and the mechanical work was of the best quality. While the cable was new the results were fair, though loss by seepage rendered it impossible to produce normal light.

It was found impossible to operate telephone wires in the same or adjacent pipes. The company soon abandoned the system, and when its cable was removed, it was found the insulation had so rotted or softened that considerable lengths of the wire in many places, were stripped bare.

With the alternating system, some wires have been undergrounded in Springfield, Mass., and in Denver, Col., and a small amount in Pittsburgh, but the voltage is only half that of the arc light systems, and even with this low voltage, the lead covered cables have not been in use long enough to determine the question of their success.

The difficulty of explosions from gas has been met with many times at Chicago, New York and elsewhere, as well as at Philadelphia, and seems insurmountable where gas is employed. At New York, men have been suffocated in the manholes, and in the Western Union building, the escape of gas from their conduits has been almost unbearable. At Detroit, an explosion took place in October last, in the middle of the night, in a fire alarm conduit with closed manholes, and in which no wire had ever yet been placed. It doubtless occurred through the admixture of illuminating gas and sewer gas, or other exhalations in proportions to explode spontaneously. The manhole cover was thrown high into the air, the street was torn up, and the paving blocks were scattered over a distance of eighty feet or more.

The problem of undergrounding arc light wires is by no means solved, but appears to-day to be further than ever from solution owing to the utter failure of systems which apparently had all the elements to insure success. In this emergency municipal bodies must suit their action to the facts. To legislate arc light wires beneath the ground when no practical systems is presented for accomplishing that end, is actually and literally to bury the system. When a city is so sanguine of the soundness of its judgment, the remedy would seem to be for the city to provide conduits and the necessary cables, guarantee them success, and then compel lighting companies to rent their lines at a proper figure, or failing so to do to quit the field. Summary action on any other basis is incompatible with that justice and equity, which it is the inherent right of every person to demand and receive. Any other course is to discourage enterprise and to ruthlessly impair or destroy capital invested in good faith.

The difficulty usually met with is a peculiar and unreasonable one. Municipal and legislative bodies view with suspicion lighting companies, their officers, stockholders, and everybody connected with them. It seems to be assumed that because the companies make a certain showing of facts, the facts must necessarily be exactly the contrary, and they legislate accordingly. Thus, at Detroit, in opposition to letters produced by the lighting company alleging repeated trials and failures at Washington, Philadelphia and Chicago, the mayor, unquestionably in good faith, reported to the council, as the result of his personal investigation upon the spot, that no electric light wires had ever been buried in the city of Washington, a most glaring error, yet this was followed by a report of the committee and unanimously adopted by the council, that the underground systems of electric arc light wires were entirely practicable and were in successful use at Washington, New York, and Philadelphia. At Cleveland, recently, the strongest argument in the underground struggle advanced by the city was that the wires of the Thomson-Houston Co., of Detroit, were operating underground in the Dorsett system, whereas there was not a foot of arc light wire underground in Detroit. To combat this unreasonable and unreasoning prejudice, the question whether any system yet discovered is practical and sufficient for the purpose should be thoroughly, exhaustively examined and an elaborate report made and published, with full data upon which the conclusions are reached; this should be done by a board of competent and eminent men of national repute, entirely disconnected from the electrical business, men who could be gathered from the scientific chairs of our largest colleges and polytechnic institutes, and it would rest with the interested companies of this association to contribute from their own funds or to influence the necessary contributions by the councils of their respective cities to pay the necessary expenses of such an inquiry.

Underground Conductors for Electric Currents.

BY JESSE M. SMITH.

The question of underground conductors of electric currents is one which every person interested in electricity should study fairly and with a predetermination to solve the problem. It is not purely an electrical question, in fact, the electrical part of it is far overbalanced by the mechanical. There is no difficulty in finding an excellent insulating material, but the difficulty lies in holding this insulator on the conductor. Many substances are good insulators in dry places; some are good under water; some in damp places; and a few will stand acid and alkaline fumes and the ravages of sewer and illuminating gas, but how many will insulate under all these conditions and in addition be substantial enough to withstand the mechanical injuries to which they are exposed when buried under the streets of our large cities?

A few years ago wire wound around with a little cotton soaked in paraffine was thought sufficiently insulated until the insurance companies had a few losses, due of course to electricity, and then we had underwriters wire. The name of this wire has sold hundreds of tons of it, but that does not prevent its grounding a whole system when it comes in contact with the least moisture. It, however, marks one state in the evolution of the perfect insulation. There seems to be comparatively little difficulty in making a cable that will carry high potential currents when constantly submerged. The conditions are substantially the same at all times. There are no alternate changes of moisture and dryness; no great changes of temperature; and very little of the destructive action of gases.

The conditions of the underground conductor are very different. Now the conductor is dry, then wet; it is frozen, and again thawed; it is attacked by sewer gas, and by the corroding action of the water leaching through the accumulated filth of the street; it is subject to destructive action of leaking gas and steam pipes and finally, but not the less surely, to the ruthless "ditch digger." These are certainly formidable obstacles, but a number of them have already been overcome and the others must be.

Public opinion says the wires of all kinds must go under ground, and electricians, engineers, and capitalists must find the means of doing it. The question resolves itself into three parts: 1st, the electrical insulation of the conductor; 2d, the protection of the insulator from the effects

of moisture and corrosion; 3d, the protection of both from mechanical injury. The question of electrical insulation seems to me to be solved by at least six of the standard compounds now in daily use. The second part of the question is the most serious. If any of the standard insulations can be enclosed so as to be protected from direct contact with moisture their chances of life are certainly improved, but if they can be hermetically sealed, they should be practically indestructible, provided, the casing is indestructible.

We single out as among the best materials from which to form such a casing, iron and lead. Cast iron, underground, will last a great number of years, as shown in the case of gas and water pipes. but it cannot be obtained in lengths much over thirteen feet, and the numerous joints multiply the chances of leakage. The conductors must of necessity be drawn into the pipe after it is in place. The conductor must be considerably smaller than the pipe, and therefore moisture will creep in between the two. Wrought iron pipe, if well coated with asphalt or some similar substance, will last a long time. It may be had in longer lengths than the cast pipe, and the joints are more easily and surely made. If screw threaded joints are used, the conductors must be drawn in, with the same objections as with the cast pipes. If the lengths of pipe are prepared with the conductors in them before laying. joints must be made in the conductor as well as in the casing, at short intervals. Joints are the bane of electrical construction. From the dynamo to the lamp and return, the current is forced to pass joints which frequently offer more resistance than a 1,000 feet of wire. At these joints the insulation, instead of being better than at other points of the conductor, is generally worse, and oftentimes none at all is found. It is not strange that the current should seek an easier path home, and take to ground, rather than be forced through the accumulated resistance of all these joints. I will venture to say that, of all the failures of underground conductors, 90 per cent. are directly traceable to the joints, and for that reason it is desirable to have as few as possible.

The conductor may be obtained in, practically, any length, and the insulation may be put on continuously, but in order to have a continuous casing it must be formed of some soft and textile metal which can be closed about the insulated conductor in the course of its manufacture. Lead seems to be the only commercial metal that will find these conditions, and there are objections even to it. Lead is soft and easily punctured and offers little resistance to crushing or bending, and is attacked by rats.

On the other hand, the corrosive action of the earth has little effect upon it; while its pliable nature permits of its use in many places where iron pipe could not be used. Being soft and ductile it can be brought into such close contact with the insulation as to prevent or at least retard the creeping of moisture between the insulation and casing. It seems to me therefore that lead casing offers more advantages and less objection than any other form of protection to insulation as yet open to our use.

The third part of the question, viz: the mechanical protection of the casing, and hence the conductor, is not so difficult a matter.

If an iron casing is used, little or no protection is needed. The pipe is strong enough in itself to withstand any ordinary abuse. If lead is used however it should be kept from contact with sharp stones, bits of glass or metal and have something about it to warn the ditch-digger before he strikes it with a pick.

An ordinary square wooden box is oftentimes sufficient. If it does rot away it leaves a bed of soft mould. The box may be made of white oak well creosoted, in which case it will last until the next generation finds something better.

If the underground conductor is to come into practical every day use, it must be so constructed that it may be tapped at any point, as readily and with as much certainty as a water main is now tapped. How many miles of lead water pipes are now buried in our streets? They are not protected by boxes or conduits or any kind, yet it is comparatively rare that we hear of their failure. If such pipes filled with water can be laid in the earth without protection, why cannot a lead pipe filled solid full with copper and insulation be buried with even more success? Good workmen can certainly be found who can cut a conductor, splice in a branch and solder it, replace the insulation, and finally wipe a joint on the lead casing, with as much ease and certainty as a plumber can make a joint in a lead water pipe and have it stand 100 pounds pressure.

In a general system of distribution there are two classes of conductors, one which we may call through mains or feeders, and another service mains. A number of through mains may be bunched together in a cable, under one casing, where they run in the same direction for considerable distances. These may be drawn into conduits as they are not to be used between the main distributing points. Service mains must, however, be so constructed that they may be tapped at any point, and that very readily.

Large sums of money have been spent in New York and elsewhere on conduits for electric conductors. Are conduits necessary or desirable in electric lighting? Service wires are of no use whatever, if placed within them, unless manholes are provided at every 100 feet. Through mains are certainly well protected when drawn into conduits, but at a great expense. No engineer would, I think, at this day, risk putting a conductor in any conduit, which he would not be willing to trust under water or laid directly in the earth. Why not take one-half of the money which these conduits cost and use it in buying thicker lead casing and bury the conductor in the ground or in a common wooden box?

The underground conductor of the future, I believe will be formed with a core of copper cable thoroughly insulated by any of the standard and well tried compounds; protected by close fitting lead casting, thick enough to resist mechanical injury, and buried in the earth in such a manner that it may be tapped at any point. But where is the money coming from to pay for these conductors? Whenever electric light plants are installed in a thoroughly mechanical and substantial manner, with due regard to the most economical production of power, so that the electric light is perfectly reliable and obtains public confidence, then the money will be forthcoming. When capital enough is invested in electric lighting to enable it to cope with the vast sums which have been accumulating these many years in the gas industry, then we shall see our dynamos driven by the waste heat and refuse products of the gas works and our houses will be heated by gas and lighted by electricity.

THE PRESIDENT: The four papers are now before the association for discussion. I would suggest that the first pair be taken up first; the practical side of the alternating current, the energy of the alternating current; and let us have a general discussion on these most important topics; and then we will discuss the underground question.

DR. MOSES: I have the pleasure of announcing to the convention that we have among us this morning one of the most distinguished electricians of England, Professor George Forbes, to whom the courtesies of our association have already been extended. As he is full of ideas, even to overflowing, he will perhaps allow us to puncture him somewhere so as to enlighten us. I hope that he will give us his views in the discussion of these various papers; or in making any suggestions which he may think apposite to the subject. I know that it will give us all very great pleasure to listen to him.

THE PRESIDENT: The convention will be pleased to hear from Prof. Forbes.

MR. FORBES: While I appreciate the honor you give me, I feel that on the particular points which have been raised at the present session there is not a great deal that I can say which would enlighten the people here in America as to what has been done in Europe. At every step as I go through your different cities I see how greatly you are in advance of and enormously ahead of us in England. A great deal of the subject of the papers which have been read has referred to the question of insulation, and as to the laying of overhead and underground conductors. Our experience in England of course as to underground conductors is absolutely nothing for the simple reason that our people will not allow us to put our conductors underground. The public in England have a strong feeling that there ought not to be any overhead conductors; they would not allow wires on poles as you have them here—which is a very cheap and convenient method; and our telephone wires have hitherto been carried from roof top to roof top—standards being erected on the roofs; and there is a general feeling among the public that electric light wires ought not to be overhead and ought to be underground. An electric light company also feel that they would prefer to put their wires underground. The opinion seems to be different over there to what it is here. The idea in England is not so much to make a cheap outlay at the start, as it is to make an efficient system—a system which it will work afterwards. It is the general opinion of a great number of companies that the best arrangement could be got by underground work. However, Mr. Chamberlain, in 1885, thought it wise to practically prohibit electric light companies from putting their wires underground. The consequence was that for several years after that it was absolutely impossible to start a central lighting station. At the present moment the demand for light from central stations in England has become so great that the companies who are capable of doing the work are determined that they will satisfy the public demand; and the consequence is now that at the present moment central stations are being started in London and in other towns, but always on overhead systems. That is what the government has driven the electric light people in England to. I may mention that insulation which is used in electric lighting overhead work in England for the alternating current, where 2,000 volts are used, is very superior to what you are using over here. The best possible insulation, of india rubber and tape of several servings, is being used in central station lighting which is done on a large scale there, viz, from the Grosenvor Gallery in London. I have always thought that that was very wise; but I must say that from inquiries here among those who have been using alternating currents of high potential I find that a less expensive wire is certainly doing admirably and I think it is just possible that we have perhaps overdone the matter in England in the way I speak of.

I cannot speak upon the subject of T. Carpenter Smith's paper on the alternating system here. It is a most valuable paper; and one from which I myself have learned a great deal, and have taken numerous notes for our benefit on the other side of the water. With regard to Mr. Shallenberger's very interesting paper, I may say that I think those experiments which he has described are very beautiful indeed. I have been lately much occupied with the theory of alternating currents. The point which he has chiefly brought before us is this, that you must not try to get out of an alternating current circuit the work which is being done in that circuit, simply by multiplying the volts by the currents; because there is a difference between the current and the expressed electromotive courses. As matter of fact the formula comes out very simply indeed,—that the true work is really the product of the electromotive force multiplied by the line current.

I do not think that there is any point on which I can give information here; but I shall listen with great interest to the discussion. Since the subject of alternating currents has been brought up I wish that somebody had given us a little information about a question which has been occupying my attention so much during the last year in connection with alternating current—the question of meters. I would like to hear what has been done in the matter of meters for alternating currents; because it strikes me there lies one of the chief difficulties in the practical working of central station lighting. Having my own idea of the solution of the difficulty, I would like to have heard more from other people what the complete solutions are or else what are wanting. I think that would have added to the interest of the discussions on the alternating currents. I am sorry that I really have nothing to give you that would be of value to the association.

DR. MOSES: I am delighted that the article which Prof. Forbes has elaborated will appear very soon. I had occasion to try one of his formulæ, and it was practical and useful. With regard to the question which he asks about the measurement of alternating currents by means of a meter, it is, of course, a most important question, and one lying at the very root of all electrical distribution In fact, it was one of the first ideas evolved as to the distribution of electric currents over large areas for ordinary use as a substitute for gas for illuminating purposes. The question of motors was not then considered particularly, and it was resolved to adopt a continuous current, not because a continuous current machine as then known was better than an alternating machine, but simply because continuous currents permitted of the registration of the amount of electricity consumed in any work by the various methods known at that time. When that was finally adopted by Mr. Edison, who first worked in that direction, he took the electrolytic method. That had already been discovered and elaborated in a most magnificent manner by Faraday, who had theretofore discovered so many very important facts, and among them I might name the sublime law of chemical equivalents. That had been completed before, but he adopted it in his system for the measurement of continuous currents. It was simply a question of deciding on which side of the mountain range the water was going to flow. I speak of him as typical of those who have adopted continuous currents for distribution. Before this, of course, the alternating current had been used for lighting purposes; and, in fact, the first dynamo machine that was made was an alternating current one, but there were some practical difficulties in the way. And here, parenthetically, I would wish to say that so great an authority as Bacon has before said that one should beware of things—meaning by that popular reports flying about. He cited one case which will illustrate by anecdote what I mean by things, when he said that Cæsar managed to come into Italy by spreading the report abroad that his soldiers were afraid of Pompey's, the actual fact being the reverse. and Pompey's men then became over-confident, and we know the result. The fact was spread abroad among the people at one time to the effect that the Pixey machine, and other machines which introduced the alternating currents, were highly dangerous. They were used for medical purposes, and whoever has had an induction coil put through him does not want it a second time, if he is sensitively strong. For that reason alternating currents were abandoned, and for no other reason that I know of. Now, we come along to another period, when people had become familiarized with the handling of currents, and it has been desired to use the alternating currents for illuminating purposes. It has been successfully introduced, but that link was wanting which the far-seeing mind of Mr. Edison supplied in his particular system of distribution,—the meter for the registration of the quantity of current consumed. Every one is familiar with the gas meter; every one knows that while it is altogether unreliable, still it is a kind of fetich that we must worship; it may tell the truth; it generally does not; but still, it is a something. Now, in the alternating current distribution there has heretofore been no such thing. I am glad to say that I have had the privilege — one of the many privileges extended to us all here by the Westinghouse companies — to inspect every part of their vast establishment, they throwing open to us all their secret doors, and in fact focusing our attention on the things that we would like to see. And, among other things, I have seen a meter which I would take occasion to particularize here as being one most admirably adapted to the registry of alternating currents and with this excellent addition, that it will speak the truth, and with this corollary to it, that we can verify it ourselves; and we do not need inspectors to go around; we do not need to use weights and measures made by ourselves. I have to speak guardedly of this because I was told at the time that the meter was shown to me, that, while it was shown still, for certain reasons connected with the taking of European patents, and such things, it was not desirable that the particulars concerning it should be promulgated; but I vouch for its success and accuracy. That meter is absolutely positive; it is simple, accurate and cheap. It cannot get out of order. We cannot doctor it. It is there to speak as truthfully as the current itself. I am also very happy to say that a meter, a most ingenious and practical as well as scientific piece of apparatus, has been invented by Prof. Forbes, which I have not had the pleasure of seeing, but which I have read much about, and which also answers many of the conditions. Now, gentlemen, I think that if you will take the answers of Prof. Forbes in a more earnest way than you took my first proviso about the success of the alternating system; and if you will only accept that statement, you may go home perfectly satisfied that hereafter alternating currents will be sold by the measure, by the quantity of the current absolutely consumed, and that the supervision of the bills charging for that current can be overlooked by the consumers themselves without any difficulty whatever.

MR. LOCKWOOD: I would like to ask Prof. Forbes a few questions with regard to underground wires in England. In 1881 and 1882 I had occasion to be in London and investigate somewhat while there the underground wires of the arc light company, or of two companies especially—they were the Brush company operating the Brush system, and the Electric Light & Power Generator company of London, operating the Weston system. I understood while there that within one year's time the Brush company were forced to renew three times their cables which they had laid down in Cheapside in the lower part of London, and that each time they put in the kind of insulation that the professor speaks of as being preferable in England—the india rubber insulation, their cable being laid at that time by the India Rubber & Gutta Percha Telegraph company. I do not remember as the Weston company had replaced theirs so many times; but I think they were replaced twice. I would like to ask Prof. Forbes if he can give us a few points in regard to these companies and whether they were ultimately successful in getting a cable which would stand the potential.

PROF. FORBES: I cannot answer that quite fully. I can support what you say has been said about the failure

of the Brush company's cables; but I do not think that the statement is correct that they were the work of the India Rubber & Gutta Percha Telegraph company. The cables certainly were continually showing faults in different parts; and enormous quantities of the cables had to be laid; and, even when they were working at their best, the insulation on the line varied enormously with the weather; so much so that on some days it was really almost impossible to work them. Eventually, as was stated just now, the whole of the cables had to be taken up The best underground cables that I know of are at the work of the India Rubber & Gutta Percha Telegraph company, where they have had their cables lying for about six years, and lighting the whole of the arc lights in their large works. They are laid in a conduit, which, however, is not water-tight, and the cables in some parts are dry, and in some parts are wet, and in other parts are alternately wet and dry; and they really undergo serious changes by the action of the water, as could be expected; and yet they have been maintained admirably during the whole of that time. I think that is all the information that I can give on that subject.

The association then took a recess until 2.30 P. M.

Afternoon Session.

The convention was called to order by President Morrison at 2.50 P. M.

The secretary read a communication from Mr. Benjamin Rhodes, manager of the Brush Electric Light company of Niagara Falls, inviting the association to meet at Niagara Falls next summer. On motion of Mr. DeCamp the communication was received and filed.

The committee on amendments to the constitution, consisting of Messrs. Leggett, Weeks and Duncan, submitted the following report:

"The committee on amendment of the constitution respectfully recommends that Article IV of the constitution be amended to read as follows: The president and vice-presidents shall be elected by ballot to serve from the close of the annual meeting at which they are elected until the close of the next annual meeting, and the same person shall not be eligible for the office of president or vice-president for two successive terms.

"The treasurer and secretary, who may be one and the same person, shall be nominated by the president, subject to the approval of the executive committee which shall have power to fix a proper compensation for his services subject however to the approval of the association. The executive committee shall be chosen by ballot at each meeting, either annual, semi-annual or special, to hold office from the close of the meeting at which they are elected until the end of the meeting at which their successors are chosen."

MR. MASON: I desire to make a motion to be followed by another, and in order that the drift of my first motion may be understood, I would like to announce what the second will be, provided the first shall be adopted. I should like to move that this report be laid upon the table, in order that afterwards, if it shall be laid upon the table, I may move that a committee of five upon the revision of the constitution shall be appointed who shall report at the next meeting of the association. If the first motion is seconded I wish to add a word of remark.

The motion was seconded.

MR. MASON: It is desirable, in the opinion of a number of the members of the association that several amendments should be made to this constitution, particularly, I might say, regarding the last article, which allows what seems to some to be rather loose action, namely that amendments may be presented and acted upon at the same session of the association. But without particularizing further I have made this motion in order that we may have this whole question of the constitution brought before a competent committee who shall have time to consider the same and report to the body after due deliberation, that we may also have time to think the matter over and act consistently and intelligently.

MR. DECAMP: I would favor the motion, provided, that the committee was appointed and that the consideration of this amendment was the first order of our next meeting. I think that would meet the views of a good many people here who seem to want this adopted at once.

THE PRESIDENT: Before calling for a vote on this, I beg to remind you that in my judgment amendments should only be acted upon in full meetings. You have under consideration now a matter of the greatest importance to the future success of the association, and while I lay down the robes of authority, so far as the presidential chair is concerned, yet I expect to be around when the other fellow is in the chair, and I would like to have a full expression on all matters of this kind and I hope that neither Mr. Mason's motions nor Mr. DeCamp's suggestion shall be allowed to pass unnoticed. I beg that you will discuss them, turn them over and over and see how they look.

There being no discussion a vote was taken upon the motion to lay upon the table, and the motion was carried.

THE PRESIDENT: The motion having been carried the report of the committee will be the special order upon the first day of the re-assembling of the convention.

MR. MASON: I now move that a committee of five be appointed by the chair on revision of the constitution.

The motion was carried and the chair appointed as the committee, Mr. Mason, Mr. Leggett of Detroit, Mr. Phelps of New York, Mr. Stanley of Bridgeport, Connecticut, and Mr. Porter of Pittsburgh.

MR. DECAMP: I move that pending the adoption of the amendment to the constitution bearing on the subject, the salary of the secretary and treasurer be fixed at $900 per annum.

The motion is carried.

New York was selected as the place for the next convention, and the election of officers resulted as follows:

President, S. A. Duncan, Allegheny County Light company.

First Vice-president, E. R. Weeks, Kansas City Electric Light company.

Second Vice-president, A. J. DeCamp, Brush Electric Light company, Philadelphia.

Executive committee, Dr. Otto A. Moses, electrician, chairman; J. Frank Morrison, Brush Electric Light company, Baltimore; E. T. Lynch, jr., United States Illuminating company, New York; Frank Ridlon, of the Baxter Motor company, Boston; W. L. Strong, of the Brush Illuminating company, New York; T. C. Smith, of the Keystone Electric Light company, Pittsburgh; E. F. Peck, Citizens Illuminating company, Brooklyn.

MR. SUNNY: The statement was made this morning in the very excellent paper read by Mr. Leggett that, while it was entirely practicable to work telephone and telegraph wires underground, it was not practicable to do so with electric light wires. I remember distinctly that six years ago when the question of putting wires underground in Chicago first came up, the telephone interest gathered its experts, and in meeting assembled they each and every one avowed with all sincerity and earnestness that, while it was possible to work telegraph and electric light wires underground, it would be utterly impossible to operate telephone wires in that manner. The amount of crow that we have been compelled to eat in that time can be estimated upon when it is understood that there are 2,000 miles of underground wire working in Chicago to-day. As a matter of fact the whole electrical interest opposed the measure and left no stone unturned to defeat it. The more they fought the greater became the general clamor for the removal of the wires. The same thing occurred to which Mr. Leggett referred as having occurred in Detroit, the statements put forth in good faith and all truthfulness by the electrical fraternity, were discredited by everybody on the other side. The authorities exercised their power in its severest form by ordering the removal of every pole and wire from the public streets within a specified time. The prohibition included the entire city of 48 to 60 square miles, acres upon acres which is vacant; miles upon miles of the streets of which are uninjured and sparely settled and alleys in passing through which one instinctively holds his nose and breathes as little as possible

The point that I think can be made is, that it is not the best policy to fight a measure in which the public seems to be so greatly interested, but to find a way to give them 10 or 15 per cent. of what they ask for if in reason it can be done. I think now that had this cours been pursued in Chicago, that we would now be able to string wires in the air outside of a limit of two or three square miles. Chicago has a thousand arc lights on underground circuits in the center of the city, the greater number of which are in the districts served by the main station located on the Chicago river at Market and Washington streets. Most of the lighting is east of this point, so that 25 circuits or 50 wires, run practically together for 2000 or 3000 feet.

When this station was established several months ago a conduit of 12 creosoted wooden tubes was put down to connect with the Dorsett conduit built four years ago The Dorsett conduit is made up of pipes having seven ducts or holes 2¼ inches each. Six lead cables $\frac{3}{32}$ inch insulation, number 6 gauge, were drawn into each duct. Lead cables were used in preference to anything else, because of the difficulties experienced in maintaining the insulation where other makes—a good many of them considered first class—had partly or wholly failed. Many of the conductors having no lead covering have done and are doing good service in various parts of the city, but in the business portion where the earth is saturated with water gas and sewer gas, which circulates more or less freely through the conduit, nothing but lead seems capable of withstanding their influence. The 6 cables in each duct were madeinto three circuits—3 positive and 3 negative—and this arrangement is probably responsible for some of the trouble experienced. It was found that although the insulation measurement of the lead cables in the conduit was very high—considerably above the megohm—and the insulation beyond the point where the lead cables ended and where some other wire was used, was, say 500,000 ohms, a short circuit would form, generally within 1,000 feet of the station, between the two sides of the circuit. The heat generated at the point of the short-circuiting would melt the lead in the adjacent cables so that in one instance all six wires were rendered useless. Where this occurred in the Dorsett conduit the destruction did not go beyond the six wires, while in the creosoted wooden tubes on another occasion not only were the six wires destroyed, but the inflammable material of which the conduit is constructed resulted in the burning out of the entire conduit and the 60 cables in it. The cold weather of three months had frozen the earth to a depth of four feet, but when the street was opened it was found that the fire had taken the frost out of the earth below a foot from the surface, and that there was left for a distance of 12 feet a few charred sticks, the bare copper wires and in the bottom some lumps of lead. Iron pipes were put in and lead cables of $\frac{5}{32}$ insulation used—four of which were put into each duct or iron pipe. This heavier insulation coupled with the redistributing of the circuits so that positive wires are grouped and kept away from negative wires, will probably result in eliminating this source of trouble.

Looking for the cause of these burn-outs it was found that they occurred on circuits carrying as few as 20 lights, or 900 volts and 10 amperes, and on circuits carrying 48 lights, or 2,160 volts and 10 amperes. They generally occurred near the station, although there was an insulation of 6-32 in. between the two sides of the circuit measuring considerably above a megohm, and there were weaker places beyond, indicating that the nearer the station the greater is the liability of short-circuiting.

It seems incredible that the 3-32 in. insulation around each conductor would not carry this voltage, while the same make of cable of 2-32 in. carries a greater voltage in another part of the city. We could not, in any instance of a burn-out, find that the abnormal resistance had entered the circuit beyond the place where the burn-out occurred. On the contrary, as soon as the damage was repaired, it was found that the circuit was in good order. Without being entirely at rest as to the exact cause of burn-outs, we have adopted what might be called a whip-handle method of insulation—very heavy at the station and tapering towards the outer end of the circuit. This, it is expected, will enable the conductors to hold the current within them under all conditions.

So much work has had to be done in the main route on account of the burn outs that we have had to make almost constant use of the manholes in the conduit. We find now that these manholes are all too small, and must be increased from 3 ft. 6 in. diameter to 6 ft. if possible. The suggestion is made that the latter size ought to be secured wherever possible, because of the impossibility of properly putting away the labyrinth of wires and cables that must be provided for at these points.

MR. T. C. SMITH: I wish to state that our company here in Pittsburgh is probably as much interested as any company in the country in aerial wires. We have an enormous amount of pole line already set up in this city, and we are doing immense business from that pole line, and I do not know that we should feel inclined to take the whole of that wire down, and go underground within a year, or within two years. But it is very evident that the public demand is urgent, that the wires be put underground wherever feasible, and our company has without being asked by the city, and without any ordinances being passed to compel us—has voluntarily undertaken to try the experiment thoroughly. We have seen a great many people try to put their wires underground, and in most of the cases which have come under my personal observation, the work has been done in such a manner that it is not a wonder that the cables burned out or that they ever got current through them. As Mr. Smith, I think of Detroit, has remarked, it is much more an economical question than an electrical one. With regard to one of the conduits of which Mr. Leggett spoke in his paper, the conduit in Chestnut street, Philadelphia, I happened at the very time that the conduit was being put down there to be connected with another company in Philadelphia which was also putting in underground conduits. The underground conduits which our company laid were nothing but a lot of tin tubes put in a wooden box filled with pitch, and we hauled into it first glass, lead covered, insulated cables. We run them for six or seven months without the slightest hitch and without a single burn-out. At the time that the cast iron conduit was laid in Chestnut street it was laid without any attempt whatever to keep it water-tight or air-tight. It was nothing but a iron trough in two halves and they made the absurd attempt to keep it air-tight by putting putty along the edges. When the cables were put in there I saw a good many being put in, and in some of the cases where lead cables were used, the ends of the cable were simply stripped for two inches of the lead, twisted together, and three or four turns of kerite tape put around it; yet that has been cited as a dismal failure of underground wire. Now I am not by any means arguing that all wires must go underground, for the simple reason that companies that have spent an amount of money and have large vested interests in pole lines and wires and business cannot be compelled by any equity to remove the whole of that property and put it underground. In a great many cases it would be equivalent to sending the company out of business. But I do think that companies should endeavor in the central parts of cities, where the streets are crowded and the buildings are high, and there is no doubt that the overhead wires are a nuisance, that they should make an honest endeavor to put them underground. With first class work I see no reason why underground wires should not be successful. We have heard a great deal about the punching of holes through these cables. Any one who has had anything to do with arc light machinery knows that if you take a 40-light Thomson-Houston machine, or a 60 light Brush machine, and open the circuit suddenly you will discharge the fluid magnets into the line, and if there is any weak spot in the insulation it will go through it at that instant. We have demonstrated it over and over again. I think if the gentlemen who are trying underground wires will simply shut their dynamos down regularly by either short-circuiting the armature or shunting the field circuit, that they will do away with a great deal of this punching of holes in the cables. In laying down three or four miles of lead covered cables we cannot expect to find them perfect in every part. There will be pin holes occasionally, and the best inspection will not always discover them; but we have no right to assume, because such things as that occur, that the plan is impossible. There is not a man here present who has been in the electric business for a year who has not had a hundred cases of open circuits and short circuits on his overhead lines. The question is not whether underground wires are feasible or not, but whether we cannot get them established with about the same trouble we took to get our overhead lines in position. I am interested in a company in Philadelphia which is running the underground system entirely. We started with a 200 volt direct current system. We knew that if we started that company the wires would have to be underground—that there were no more overhead ordinances going to be passed. We realized what we were attempting, and we resolved to spare no expense to do the thing properly. When we purchased our cables from the company—they were all lead covered cables—we told that company to send us their most experienced men for the splicing and laying of those cables. We paid their expenses cheerfully. We not only had them make the joints, but we watched them. We

started at the station and turned the current into those lines. We ran there for six months without a trace of leakage, and then we changed over to the alternating system. We put a thousand volts into those cables, and they are running to day and have been for nine months, without a single ground having occurred on them. We have fifteen miles of cables buried all told. We have had the question before us whether it would not be possible to run the alternating current in the same box with telephone and telegraph cables. At the request of Chief Walker, the city electrician, we ran in the Long Distance Telegraph Company's conduit, 1500 feet of 3-conductor cable. On the two outer wires we put our alternating current, and we placed a 30 light converter in the chief's office. Into the third wire we conducted his telephone and there is not a trace of interference on it. The telephone company, of course, had given Chief Walker permission to put that cable in their box, but they were a little nervous about the result, being afraid it would knock out their whole system between Philadelphia and New York. After we had been running about a week they came to us and wanted to know when we were going to start up. We told them that we had been running about a week, at which they were very greatly surprised, and they have made no objection to the occupation of the box by us. Of course I have had no real experience with arc lights underground, that is high tension currents—beyond the fact that when I put down my lead cables in Pittsburgh I used a 65-light Brush machine to test them with. I would not, when testing them, subject them to the strain of opening the circuit suddenly upon them. I do not think it would be policy to do so. Chief Walker, in Philadelphia, is running some four or five miles of lead-covered cable on his arc circuits. He has had one or two burn-outs. He had too strong an air line for one section, because he could not dig up the streets, being winter. But he did not expect to put down a perfect job the first time. There is one thing I would like to ask some questions on. It has been stated that a direct current arc light cannot go underground. I do not think that the gentlemen who make that statement fully realize what a tremendous weapon they are putting in the hands of the press against them. I am not speaking now as an alternating current man, but as a member of the association, and as representing a lighting company which is interested in overhead wires in so far as they do not interfere seriously with public safety. We have proved beyond any question that the alternating current can be put underground, and can be put in lead-covered cables, without any danger of loss of current. If the direct wires cannot go underground, the alternating can. And it may be that we shall be called upon to put in new apparatus which we do not want, simply because it cannot go underground. I think that in a case of this kind it is not the technical press we have to consider; they can realize the difficulty and danger and troubles of going underground. But it is the public press we have to consider. While they certainly do not always express public opinion, they have a good deal to do with molding it, and a persistent attack by the press on a lighting company will compel it to do what they desire. I think the sooner this question of underground wire is placed fairly, the better it will be for all of us. I have had a good deal of consultation at various times with Chief Walker in Philadelphia, and he made the statement to me that some eighteen months ago, before he would recommend the city to spend any money in the experiment, he wished to make a test of certain cable, and he got a length of three hundred feet of cable. This was cut into two parts, and placed on the two poles—one on each pole of a Brush sixty-five-light dynamo, laid in the yard of the station with the mud and water all around, and then connected with the air line. After they had run a few days a fault was developed in the cable and there was found to be a hole punched right through the insulation. I am not sure but I think the other connection was found at the end of the wire where it was bared to attach to the air line. The defective part was cut out and he has it in his office, and as I was under the impression that he had been using that wire in that way ever since, I telegraphed him this morning as follows: "Is the three hundred feet of cable originally laid in the yard still in daily operation?" I received the answer from him: "To the best of my knowledge it is;" and I will ask Mr. Law whether that is the case or not.

Mr. Law: That cable has not been in use for the last five months at least.

Mr. Smith: Very good. Then Chief Walker is mistaken. But at the same time he laid a good deal of cable in the upper part of the town, and that cable is still in use. Now the statement has been made that in Chicago the average capacity of the machines was forty-five lights, and the average circuits twenty lights. I do not know—but I think the man in charge of the station has shown poor judgment in dividing his circuits.

Mr. Sunny: If you will allow me, I will explain that in one word—we have put out more circuits than the present business requires.

Mr. Smith: Exactly. I presumed that you have done as I have done in Pittsburgh. I have kept all of my circuits the size of my smallest unit. But the fact that the circuits and machines do not agree is no proof that it was done because the wire was defective. I would like to call on Mr. Wilbur of the Jenney company who has laid a good deal of cable in Philadelphia; I would like to ask him if his cable is in use.

Mr. Wilbur: I would say for the information of this association that last spring we laid over two miles of underground cable in Philadelphia in the grounds of Girard college. We are running 47 lights on two 25 light machines. We have never experienced a particle of trouble with the cable from the time it was laid up to date. Where the cables came out at the top and connected with overhead wires there have been one or two grounds and leaks and lightning troubles, but no serious defect of the cable. But I am glad to think from our experience there that there is some small grain of truth in the claim made that you cannot get as great a number of lights out of a given dynamo capacity in running underground as you can on overhead wires. With that exception I do not know that there is any serious difficulty in running arc light currents underground, unless it is that of expense which is sometimes prohibitory.

Mr. Leggett: How long is the longest conduit that you have in the Girard College grounds?

Mr. Wilbur: It is all one circuit, sir. It is about two miles and an eighth, I should judge. I do not remember the exact length. It is all one circuit, burning 47 lights on it.

Mr. Leggett: You go out and come back through the same conduit?

Mr. Wilbur: Yes, sir, side by side. It is the standard cable laid in creosoted boxes, side by side. They come back in the same box.

Mr Leggett: Something less than a mile in length?

Mr. Wilbur: The main circuit is about a mile in length. They loop out to the different towers and different places where we have lights.

Mr. Law: I would like to ask, Mr. Wilbur, if those conduits do not pass through passage ways that go from one building to another, and if they are not kept up to a very high degree of temperature.

Mr. Wilbur: I neglected to state—and it is a very important matter—that the buildings of Girard College are heated by steam, and those steam pipes are carried through a brick conduit. We got the benefit of those brick conduits as far as they went from the engine room at the lower shed of the grounds up to the farthest end of the building. We ran through this brick conduit, laid our wires in boxes in the conduit, and then branched out to the towers underground—laying it simply underground; and the duct is always heated in winter up to a very high temperature, and in summer it is not equally warm, because they have a circulation of air by fans, etc., to keep up a circulation of air through the tunnel. But I do not think there is any great amount of dampness in there.

The President: How much of your conduit runs in the duct?

Mr. Wilbur: Perhaps from two-thirds to three-fourths of the entire circuit runs in this brick duct. Those branches cut to the towers run through the ground.

Mr. Kinsman: There is one thing that has not been referred to in connection with this underground matter, which seems to give a great deal of trouble; that is static induction; atmospheric electricity. I would like to have some one give his experience on that.

Mr. DeCamp: Two papers have been read to-day on this subject of underground conductors—one for, and the other against; but there is one thing in which they both agreed—perhaps two, but one in particular, and that is that we must have a perfect insulation. The second is that it is only a matter of cost. Now I believe that the first one is true and no station will be operating a complete underground system until they secure that perfect insulation. In regard to the point that it is a question of cost, I think that ought to be left out until some gentleman is prepared to say just what that cost will be—not that it is only a matter of cost, that is keeping the companies from doing it, even keeping them from making a fair, proper and unbiased test. The question of cost is certainly one of very great importance. Electric lighting from central stations is now nine years old. There are organizations who have back of them probably as good business talent as ever backed up any new enterprise, and as a rule they have been organized for business purposes. They are officered and controlled by men who do not hesitate to invest their money in things that they think will ultimately pay—not to get their money back, because if that is the case, they have been, without exception, I guess, grievously disappointed. They are waiting for their dividends yet. All know—if they do not they can find out very easily—that the returns upon the capital invested in electric lighting have not been large. They have not been such that would justify the investment of money in a business which is likely to undergo rapid changes or rapid improvements carrying with them a large depreciation in the value of their property. But the business which they are doing to-day is established—the prices are established upon the basis of the cost of the present plants, and it is unnecessary to say that it would be utterly impossible for any company to go before the public to-day and advance the price of their lights. The prices of electric lights are high; they always have been; they are high to-day. They are lower than they were when they started; but they are high to-day; and that is the view that every consumer takes of it. Therefore you cannot advance your price. The cost of an underground conductor—those that are said to be entirely reliable to-day—is four or five times as great as that of the aerial wires which we are using and using successfully. Now in addition to that you have got to add the difference in cost in putting those wires down. It will run the cost of your construction up to an enormous amount. That has all got to be provided for. I will anticipate what has been said, and I presume will be repeated, that after you have done that your expenses cease practically. That I do not believe from our own experience. I would not venture to say that until I had had a long experience in it. I do not believe it is the case.

In regard to the lead-cased cables—I cannot give the reasons for it—there has been a tendency to short circuit between the wire and the lead. That shows of itself an imperfect insulation. Your lead is no insulator; it is a protector, and it does not protect when the insulation is imperfect. We do not have these troubles with overhead wires. I will state in brief the conditions of the underground wires referred to by Mr. Walker, and I will leave it without any comments as to whether that is a demonstration. I will only go back to the point where I have had the general management of the company that is operating those wires. We start out from the station and reach the first terminal of the conduit—I will give the figures—3,375 feet of single aerial wire from station to entrance of conduit; thence by 1,412 feet of single wire one side of the circuit from open conduit; thence through conduit 9,500 feet, making a loop of 19,000 feet of lead-cased cable, placed in a box six inches square, and filled in solid with pitch. Thence 30,500 feet of overhead wire, one side of the circuit to the station, making a circuit of something less than eight miles, of which about four and a half miles is underground, and part of which is one side of the circuit only. The upper section of that circuit is put in first. About half of this 9,500 feet was filled in solid lead cased cable, and I agreed with Mr. Walker at the time that was put in that it was the best I knew of—although I did not know anything about it—it was well made. That cable gave out once. The defect was in the lamp post, but it was a short circuit between the cable itself and the lead. It was put into the lamp post carefully, and there was no particular reason why it should be there so far as anybody could find out. Afterwards a defect in the circuit occurred underground. It being winter time and the ground being frozen, he strung the wire from one lamp post to another. There has been since then one defect of the same kind, which has been removed. There is another one that has been cut out all winter between lamp posts for the same reason that it is not on the poles; it is underground. More recently there is another section between poles cut out in that part of the circuit in open duct, with one side of the circuit only. In addition to that we have had what did not concern me, notwithstanding our experience in the Chestnut street conduit; that is a comparatively new section of the city—at least the gas mains are comparatively new. Down in the lower part of the city the gas mains are very old and very defective, but in this part of the city, the conduits were comparatively new, and the leakage of the gas was not supposed to be to a degree that would be likely to interfere with the conduit. There have been three explosions in those manholes within the last three months. I was favored with being on the spot when one of them occurred. It was in the first manhole where the wire came off the poles and into the side of the manhole entering the duct. When that manhole was blown off, it was broken in three pieces. The cover weighed about 400 or 500 pounds, I think. In the bottom of the manhole were three or four inches of water. I happened to notice a little spluttering of solder in the water. The man put his hand right under the lead, and he found a small hole where the current had gone through and melted the lead. There was no contact there at all. It came clean out of the manhole and went into the duct. These are troubles that are purely, in my judgment, incidental to the conduit, but there has been other trouble which I think will always exist with lead-cased wire, while it might not with some insulated cable without the lead. That is the difficulty of getting your low terminals safe at the lamp terminal. However, that difficulty would be overcome in some way or other. But it is the question of underground wires themselves. That is the history in this short time of that effort,—that is, about eight miles. I just submit whether any company would want to enter into the task of putting down 100 to 150 miles on the strength of that experience; whether they would take the risk of pronouncing that sufficiently successful for entering into a general system. For my part I would not. It would not take me long to decide that.

The courtesies of the New York Electric club house during the next convention, tendered by President Davis by telegram, were accepted and ordered acknowledged.

T. C. Smith, of Pittsburgh, Geo. F. Porter, of New York, and Geo. S. Bowen, of Elgin, Ill., were appointed a committee on transportation.

A resolution expressing great regret at the refusal of Mr. Morrison to accept a renomination to the office of president, was passed and ordered engrossed and presented that gentleman. The resolution was supplemented by three cheers.

Suitable resolutions on the death of W. S. Frear, of Buffalo, were passed, and the convention adjourned.

EXHIBITS AND NOTES.

The Westinghouse Electric company occupied handsome headquarters in rooms 35 and 36, and their hospitality and generosity were a subject of constant remark during the entire convention. Invitations were posted in different parts of the hotel inviting the delegates to visit the Westinghouse factory, and nearly all the delegates availed themselves of the privilege.

The liberal action of several of the Westinghouse companies in presenting the association with $1,150, cannot be praised too highly.

The Westinghouse business is run on the broad gauge principle. The very best business and scientific talent obtainable is secured and liberally compensated. The policy of the company together with the excellence of its apparatus has resulted in an enormous business built up within an extremely short time. The magnitude and extent of this business can be best understood by a visit to the company's factory in Pittsburgh, with its costly plant and a capacity for 4,000 incandescent lamps a day.

About a hundred Westinghouse central station plants are in operation or under construction, representing in the aggregate 350,000 lamps. Noticeable among these are the plants at Pittsburgh, New Orleans, Trenton, Savannah, Denver, Minneapolis and St. Louis. The Pittsburgh plant is that of the Allegheny County Light company. This station will soon have a capacity of 15,000 incandescent lights. The station of the Allegheny County Light company was visited by most of the delegates at the convention.

Altogether the attendance at this convention was the largest yet known. The exhibits were not of the heavy or the extensive character of the Boston convention. The different supply manufacturing companies were well represented however.

Among the new-comers was the American Waltham Watch company of Waltham, Mass., who were represented by H. E. Duncan in room 9. This company was exhibiting a new non-magnetic watch. This watch is not protected by a shield but is non magnetic in itself.

In room 33 the E. P. Gleason Manufacturing company of New York was represented by W. F. Cullum.

The Baxter Electric Manufacturing & Motor company of Baltimore, Md., held forth in room 9 as did also the Sun Electric company of Woburn, Massachusetts.

W. M. Callender represented the Callender Insulating & Waterproofing company of New York, in room 32, and the Simplex Electrical company, of Boston, made their headquarters in room 34, being represented by A. F. Mason.

The Okonite company showed samples of its wires in room 37, and was represented by W. L. Candee, and G. T. Manson.

The Electrical Supply company, of Chicago, showed quite a full line of goods in room 10, Fred DeLand being their representative.

The Geneva Non-Magnetic Watch company, through Addison Conkling, made a very handsome display of watches and testimonials in room 38.

The Standard Underground Cable company was strongly represented by J. W. Marsh, F. E. Degenhardt, W. A. Connor and G. A. Wiley, who showed samples of their wires and cables in room 32.

The Solar Carbon company, of Pittsburgh, were represented by C. B. Curtis in room 8.

The other companies who made exhibits are as follows:

Edgerton Electric Motor Co., Philadelphia. N. H. Edgerton, room 31.

Holmes, Booth & Hayden, New York. Theo. Larbig, J. L. Barclay, room 28.

Baker & Co., platinum refiners, Newark, N. J. C. O. Baker, jr., room 37.

Phœnix Glass company, New York. A. H. Patterson, room 41.

Campbell Electrical Supply company, Boston. F. E. Clark, C. I. Hague, room 39.

Bernstein Electric Light Manufacturing company, Boston. Henry B. Cram, room 39.

New York Insulated Wire company, J. W. Godfrey, room 47.

C. & C. Electric Motor company, New York. H. L. Lufkin, Geo. W. Larue, room 40.

Falls Rivet company, Cuyahoga Falls; Brock Friction Clutch; E. L. Babcock, corridor.

Eddy Electric Manufacturing company, Hartford, Conn. A. D. Newton, M. E. Baird, room 25.

Warner's Patent Electric Gauge, room 25.

Hafner's Patent anti-friction system for driving dynamos, room 8.

D. M. Steward Mfg. Co., lava insulators, Chattanooga, Tenn., room 8.

Union Indurated Fibre company, N. Y., room 8.

Anti-Magnetic watch shield, C. K. Giles, room 8.

Frisbie friction clutch, New Haven. W. M. Frisbie, room 8,

Jas. W. Queen & Co., Philadelphia, room 8.

The Diehl sewing machine motor, corridor.

Crosby Steam Gauge & Valve company, W. S. Clark, room 33.

National Conduit & Mfg. Co., New York. J. P. McQuaide, room 39.

THE ELECTRIC LIGHT.

Stockton, Cal., will be lighted by electricity on and after the 1st of April, contracts to that effect having been signed and the proper bonds filed.

A hint for electricians is found in the following industrial note made in a daily paper: "Among possible applications of electricity to domestic uses there is one which does not seem to have yet attracted the attention of scientific instrument makers. That is an electric lamp for farmers. At present the husbandman in the country employs either the familiar horn lantern invented by King Alfred and a tallow dip, or the more modern glass lantern, burning benzoline or petroleum. The former gives a wretchedly dim light, while the latter is difficult to light and extinguish, and is, moreover, very unsafe to carry about in linhays filled with straw. An electric lamp would not only give a bright light, but would be absolutely safe."

THE ELECTRIC MOTOR.

The St. Louis *Post Dispatch* thus jubilates over its electric motor car: "Wind and weather have but little effect on the Lindell company's electric motor car, dark forebodings to the contrary notwithstanding, and for the greater part of to-day the coach sped up and down the line from Grand avenue to Third street. The snow lay heavy on the ground, and the rails were frozen and slippery, but the Julien-Brush innovation laughed at all such obstacles and continued running on schedule time. This pleased the people, who have not forgotten the first sleet of the season, and who vividly remember how on sundry occasions when hard frost followed a drizzling rain, the bob-tail cars refused to bob on reaching the incline going west just below Jefferson avenue, compelling the occupants to work their passage and shove both mule and car in the teeth of a driving storm. But those who felt happiest over to-day's test were undoubtedly the Lindell people, especially Secretary Baumhoff, who can watch the motor glide by from his office on the second floor of the Washington avenue stables, when he is not himself on board enjoying the ride like a boy with his first bicycle. To top it all, both cables were in distress, the Citizens' line having lain dormant for some time past, while the Cable & Western was the victim of another breakage yesterday, some of the strands in the rope having parted. Of course the sponsors of the motor car could not be uncharitable enough to rejoice over the mishaps of rival companies, but they wouldn't have been quite human if they had not laughed just a little at some of the men who recently sneered at electricity. The Julien-Brush coach would now appear to have been pretty thoroughly tested, so far at least as adverse weather is concerned. The rails were quite slippery with mud on Sunday last when the initial trip of the new tests was made, yet the ugliest grades were surmounted with ease, and now that snow has failed to obstruct the coach, the directors are much pleased. The motor was laid up at noon, while the man at the lever consoled himself with a lunch, but it was announced that it would be running again two hours later, and would continue to do so till late this afternoon."

THE TELEPHONE.

Interviewed by a newspaper reporter as to a rumor that the Chicago Telephone company directors would discuss a plan of action to meet the city ordinance prohibiting the further laying of wires, Norman Williams, vice-president of that company, said: "We are not concerning ourselves about the city's action. Our application for an injunction is before the courts, and everything relating to the legal fight is in *statu quo*. We are not accepting new business, but the reason is to be found in a different direction. We can not serve any more subscribers without impairing the service. The limit of effective service has been reached, and every additional subscriber would mean a weakening of the service to old subscribers The system in use in Chicago is the best in the world, but improvements of some kind are necessary to permit indefinite enlargement. We are constantly spending large sums in new devices. The public knows nothing of the cost of running a telephone company in a large city. If I were to tell you that the contract price of erecting a new switch board to accommodate 15,000 subscribers would be $1,000,000, you would not believe it, but such is the fact. I do not see the justice of attacks on the telephone company's treatment of its employes. The young women receive more pay than they could earn elsewhere, they do not have to work a full day, and the only abuse they receive is from the public. I could not get a telephone operator to write on a piece of paper the names she is called by the public. They are too modest."

The new instrument, as yet unnamed, designed by Daniel Drawbaugh for use by armies on land to detect the approach of troops, or at sea the appoach of vessels, consists essentially of a microphone and registering dial. The microphone, an extremely sensitive combination of wire, is placed in a hollow iron tube, which is hermetically sealed. The microphone when it is to be used on land is attached to an iron screw with a very wide tread, by means of which it is sunk firmly into the earth. An insulated wire, which may be buried or run over tree tops as the emergency may necessitate, connects with a galvanic battery and the registering dial, which may be placed miles away. The registering dial is surmounted by a needle which works from the zero point. Underneath the dial in the small circular brass box which it covers is another needle in the form of a walking-beam. When the vibrations of sound, either by the medium of earth, water or air waves affect the sensitive microphone the needle beneath the dial is at once caused to dip. The dipping puts one end of the steel into a diminutive pot of mercury and a local circuit is brought into action, which moves the needle on the face of the dial and serves to give the alarm.

THE TELEGRAPH.

A note made recently in regard to a conversation carried on by telegraph between a correspondent of the *Pall Mall Gazette* in Vancouver, B. C., and the editor of the paper in London over the Canadian Pacific and Postal lines and the Mackay-Bennett cable, a distance of 6,900 miles, has brought to light some instances of long circuits in America. The longest regularly worked telegraph circuit that has come to notice was one which the United Press had in constant use for two years or more between New York and Chicago by way of Washington, with loops to Norfolk, in Virginia, to Louisville, Nashville and St. Louis, over 2,635 miles of wire in all. It was good in storm and shine, and was the wonder of the telegraphic fraternity, not alone because it was the longest and most complicated circuit, but also because of the rapidity with which it was worked, more than ten thousand words a night being sent over it. This wire, with a few changes which have taken nothing from the mileage, is still in use, day and night, manned, of necessity, by the best operators that can be secured.

In 1884 the Western Union Telegraph company made a contract with the proprietor of a fashionable hotel at Newport for permission to establish a telegraph office in the hotel, with the express understanding that no other company should have similar privilege. While this contract was in full force, the hotel proprietor entered into a contract with another company by which he allowed them to establish an office in the same building. Thereupon the Western Union began a suit in equity, praying that this company be restrained by injunction from operating their lines. The hotel proprietor's attorney told him to give himself no trouble, because a court of equity would never interfere when there was an adequate remedy at common law. But in this the attorney was wrong. The court did interfere and did restrain the invading company from operating its lines, and for this reason an injunction will be granted, where the damages occasioned by the breach of the contract are not readily ascertainable in money, yet where the injury is a grievous or material one. Furthermore, when the construction of the contract is clear and the breach clear, it is not a question of damage, but the mere circumstance of the breach of contract affords a sufficient ground for the court to interfere by injunction.

C. P. Huntington said recently, regarding the Anderson bill calling on the Pacific railroad companies to operate their telegraph lines for the benefit of the people: "The law allowed the Pacific railroad companies to make contracts with the telegraph companies, and, of course, they did it. That's all I know about it." Dr. Norvin Green said the bill affected the Western Union company very little, as it had its own wires along the railroads. Under the original charter the roads were given the right to arrange with the Overland and California State telegraph companies for stringing the latter's wires along the line of the roads, and such an arrangement was to be in substitution of the undertaking by the railroads to build telegraph lines. If no such arrangements were made, the telegraph companies were given the right to establish lines on the railroad on their own account. The Western Union failed to come to an agreement with the railroad company and built its lines along the road on the right of way reserved for them under the act.

Electricity in mines is one of the blessings of this wonderful age. Possibly the drink-mixer of the future may daily have his ears assailed by the order.—"Electricity in mine."

The Kansas City Electrical company, of Kansas City, Mo., has been incorporated; capital stock $10,000, divided into 100 shares of a par value of $100 each. The object of the company is to manufacture and sell electrical instruments and supplies.

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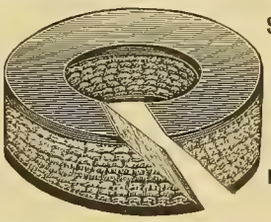

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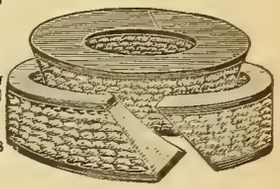

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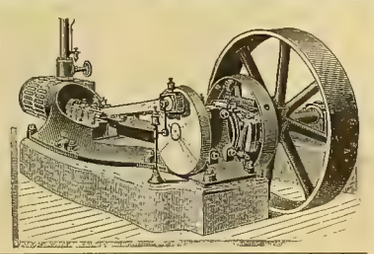

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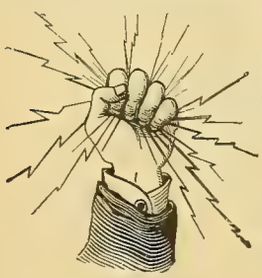

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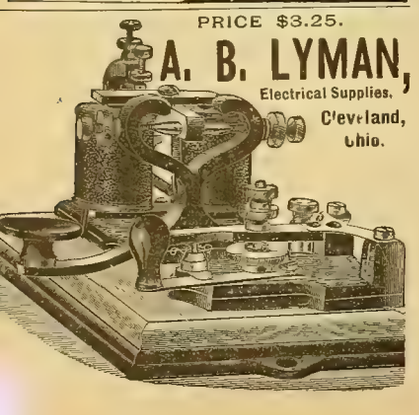

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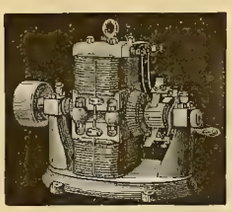

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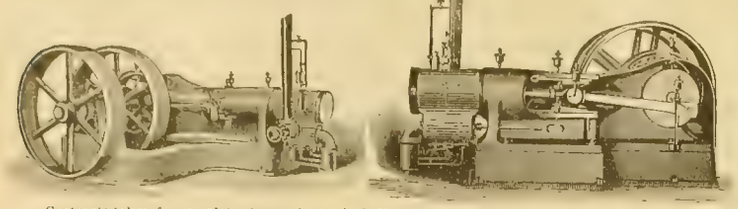

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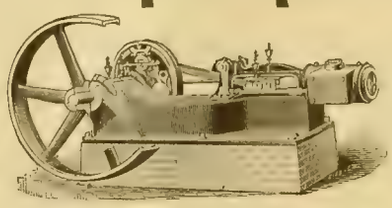

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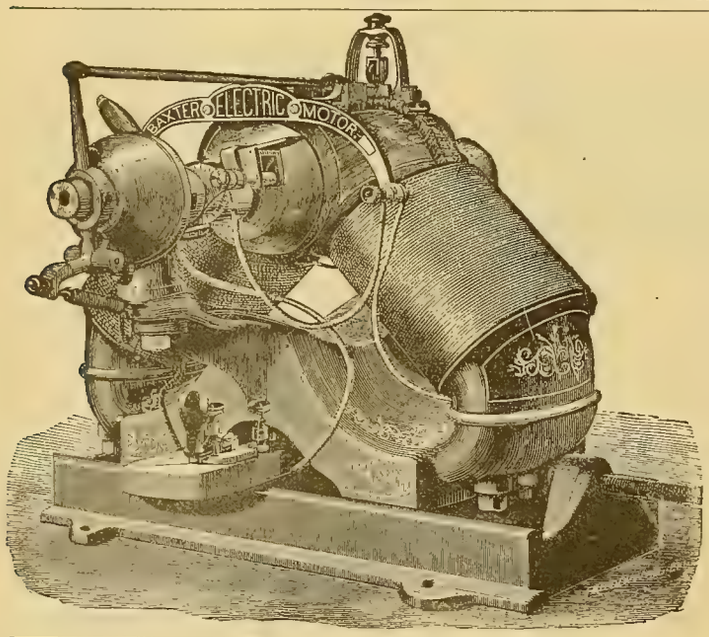

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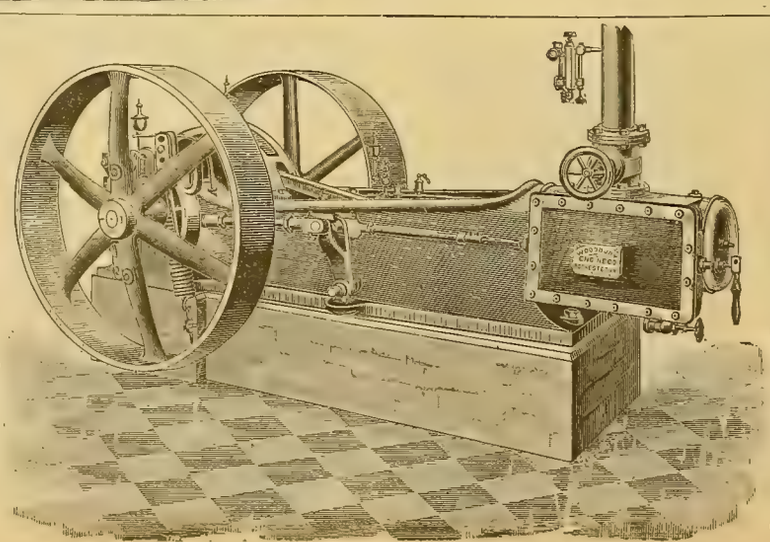

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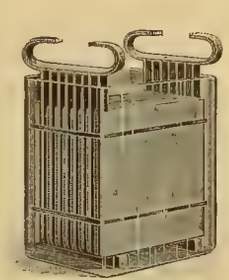

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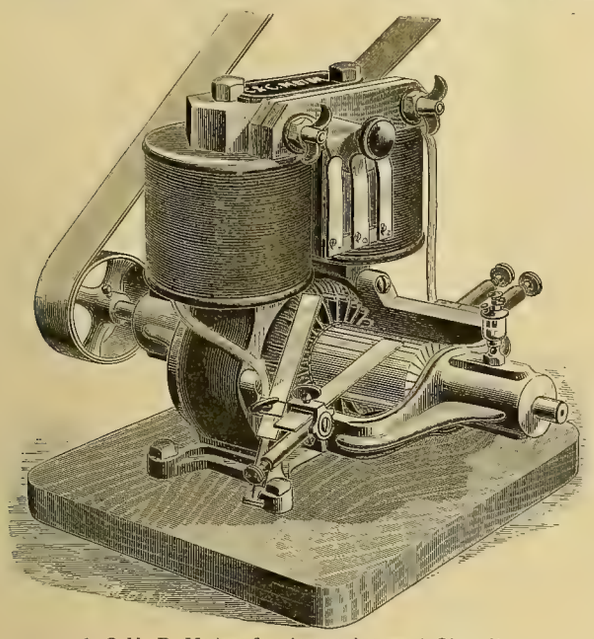

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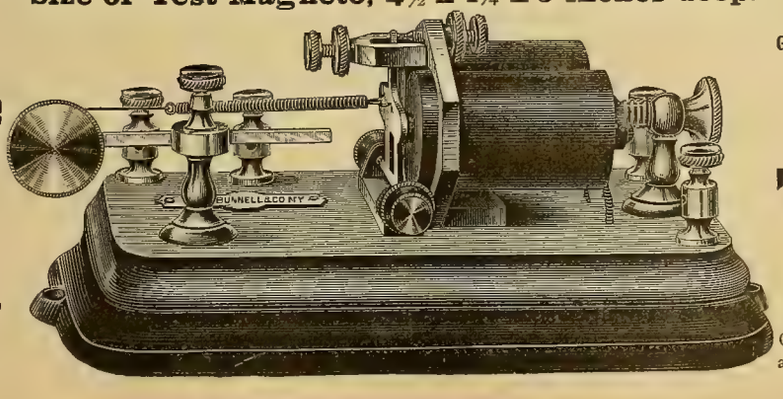

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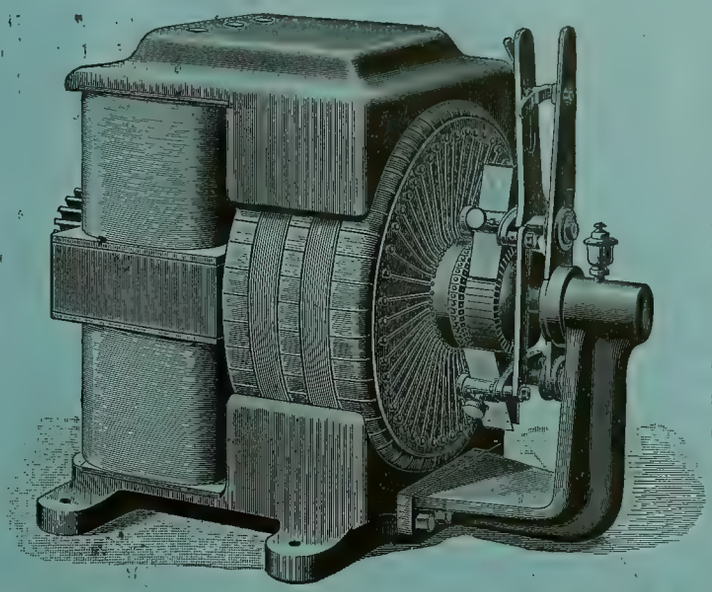

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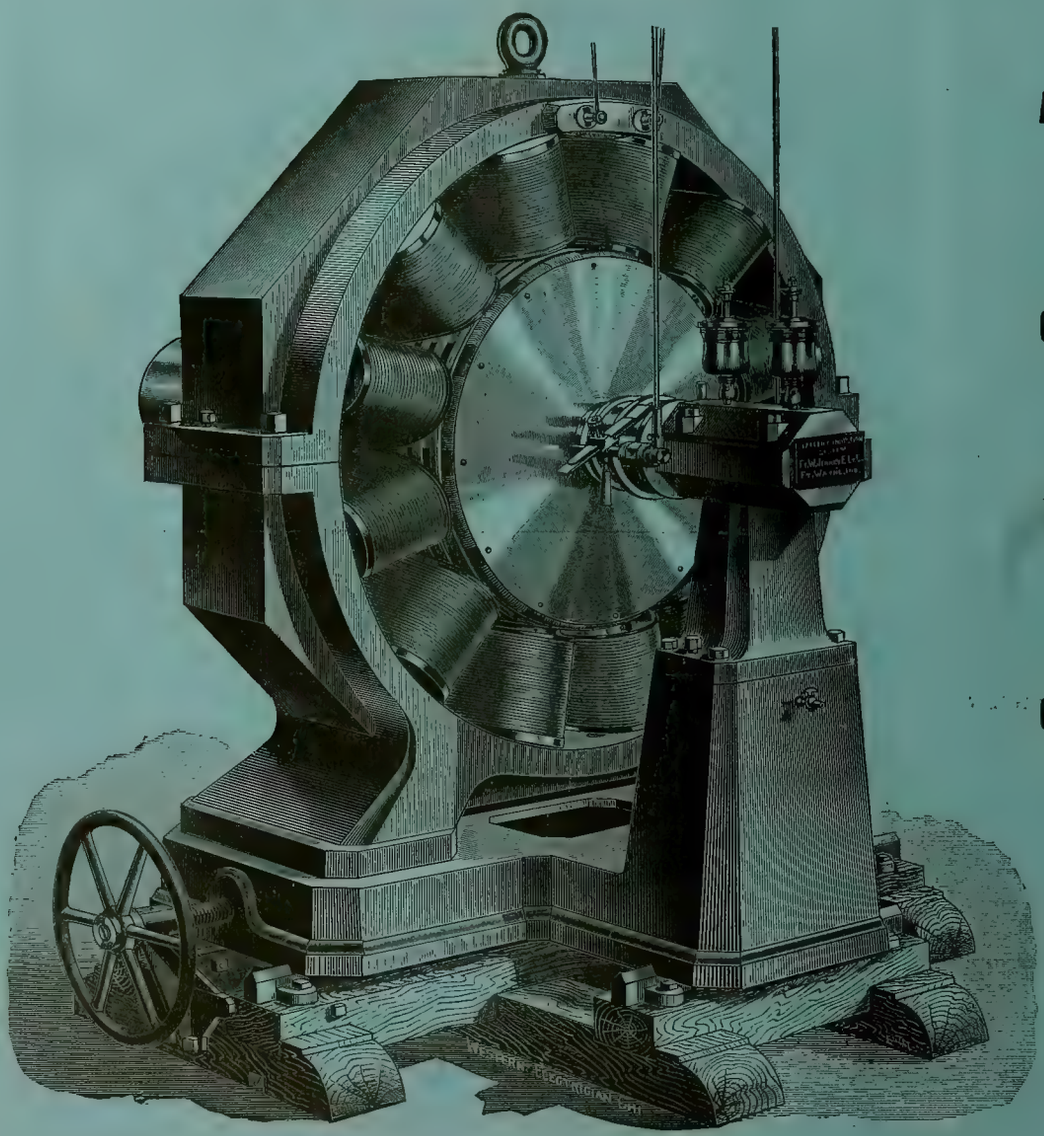

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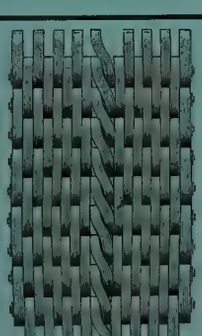

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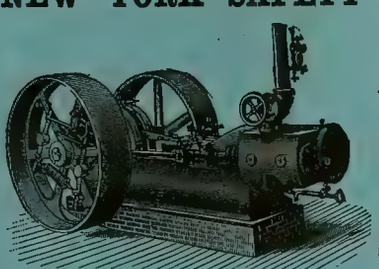
And other duty requiring close regulation of speed.



WESTERN OFFICE AND WAREROOMS:

64 & 66 S. Canal St., Chicago, Ill.

WM. A. HAMMETT, Manager.

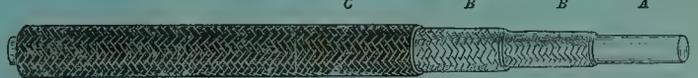
ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A



CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

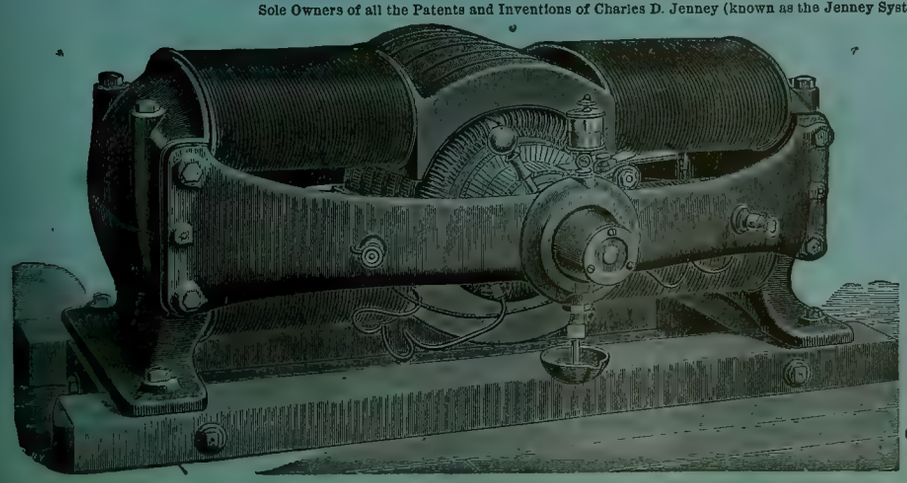
WAREROOMS: { 19 and 21 Cliff St., New York. 64 Washington St., Chicago, Ills. FACTORIES: ANSONIA, CONN.

DANIEL W. MARMON, President. ADDISON H. NORDYKE, Vice-President. CHARLES D. JENNEY, Electrician. BRAINARD RORISON, Secretary. AMOS K. HOLLOWELL, Treasurer.

JENNEY ELECTRIC COMPANY.

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to Private Yachts, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

OFFICE AND WORKS:

Cor. Kentucky Ave. and Morris St

INDIANAPOLIS, IND.

The Thomson-Houston Electric Co.

EASTERN OFFICE:
178 DEVONSHIRE STREET, BOSTON.

WESTERN OFFICE:
PULLMAN BUILDING, CHICAGO, ILL.

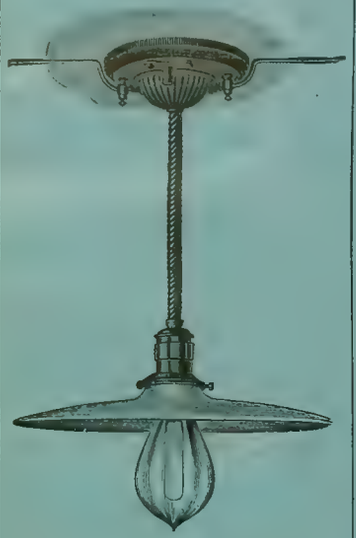
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



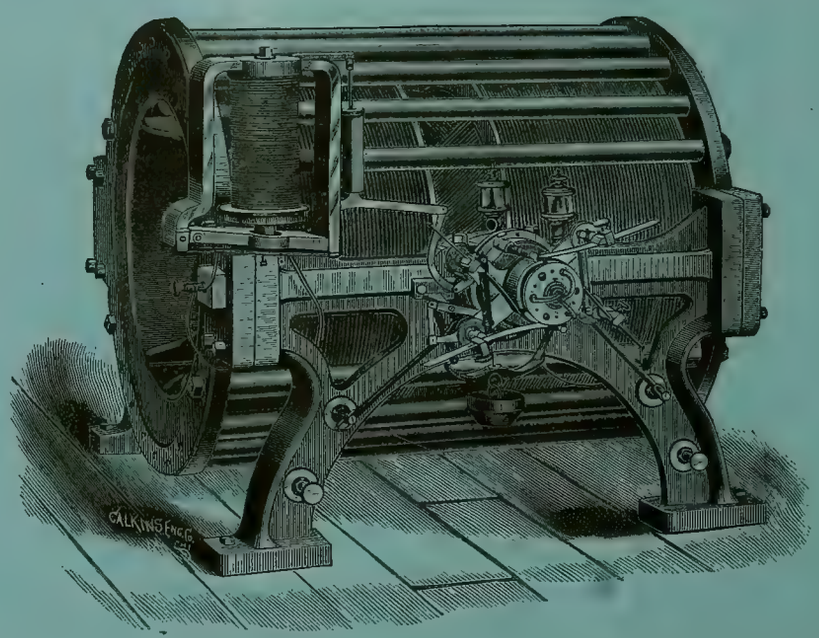
SERIES LAMPS

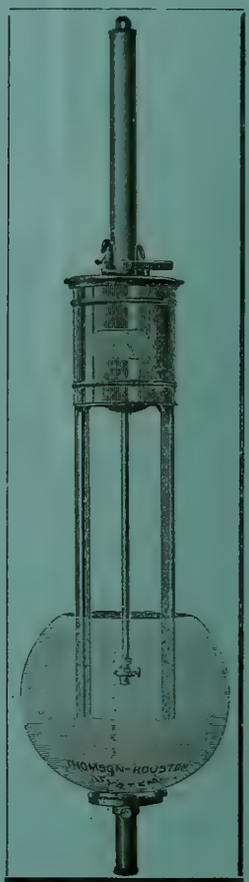
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



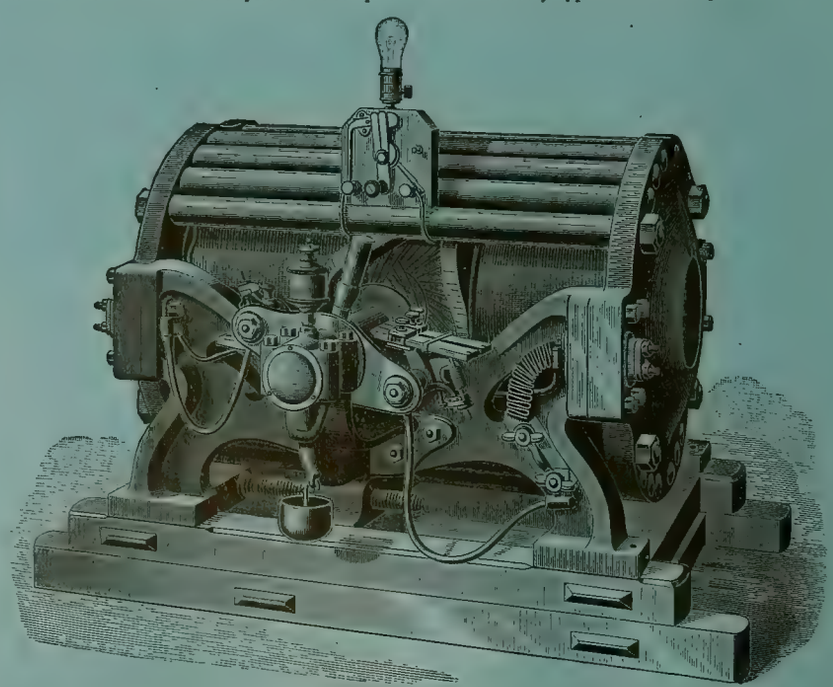


This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.



SELF GOVERNING ELECTRIC MOTORS.

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc, and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

EDISON'S NEW LAMP

IN

People's Theatre, Minneapolis.

12 16-Candle Power Lamps Guaranteed per Commercial Horse Power.

MINNEAPOLIS, Nov. 17, 1887.

EDISON UNITED MNFG. CO.,
65 Fifth Ave., N. Y.

GENTLEMEN:—The Electric Light put in my Theatre by your company is far beyond my expectations. Its system of lighting is perfect and is all that your representative claims for it.

Your light was chosen after a thorough inquiry into the merits of the different systems and I am more than satisfied with my choice. I have, beyond a doubt, one of the finest lighted houses in this country. The apparatus for controlling the light is the most complete I have ever seen. I am getting all of twelve 16-candle power lamps per horse power, if not more, and the life of the lamps averages away beyond a thousand hours.

I take great pleasure in recommending your system and you may refer to me at any time.

YOURS TRULY,
LAMBERT HAYS,
Proprietor People's Theatre.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

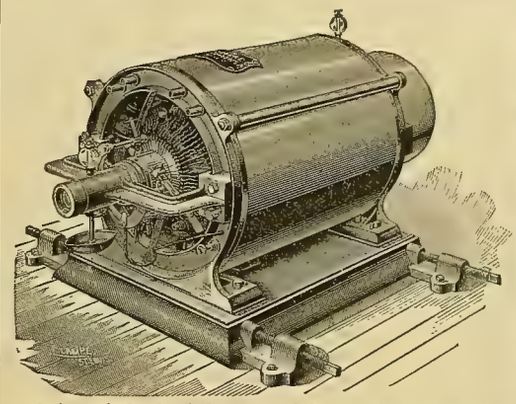
Heisler Electric Light Co.

809-817 S. 7th Street, ST. LOUIS, MO.

MANUFACTURERS OF

The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

U. S. OLD LAMP

IN GRAND OPERA HOUSE, MINNEAPOLIS.

WHAT THE MANAGER, WHO DON'T GUESS AT IT, SAYS FOR IT.

He says, after having Careful Indications of Engines and Practical Electrical Measurements made, that

348 Edison 16 Candle Lamps require 54 Indicated Horse Power.
610 U. S. 16 Candle Lamps require 53 Indicated Horse Power.

He also says that, after having purchased and used a U. S. plant for Opera House, they purchased for the Syndicate Block an Edison plant because it was offered at a much less price (nearly one-half) than that of the U. S., and because of the Astonishing Guarantee made by the Edison Co. After testing and ascertaining the facts,

THE EDISON PLANT WAS REJECTED AND PUT OUT

and U. S. PLANT PUT IN ITS PLACE, the satisfactory working of which may be understood from a perusal of J. F. Conklin's autograph letter heretofore published in several issues of this Journal. Mr. Conklin desires to say that any statements of Edison representatives to the effect that the reason of such rejection of Edison plant was because some one or more of the Syndicate Co. were stockholders in the U. S. Co. is without any foundation in fact, as not one of them has, and never had a dollar's interest in the U. S. Co. beyond the purchase of a Fourteen Hundred Light Incandescent Plant for their Syndicate Block and Opera House.

U. S. 610 LAMPS REQUIRING 53 H. P.=11$\frac{50}{100}$ per H. P.

EDISON 348 LAMPS REQUIRING 54 H. P.=6$\frac{44}{100}$ per H. P.

COMMENTS ARE UNNECESSARY.

THE UNITED STATES ELECTRIC LIGHTING CO.

C. C. WARREN, MANAGER. 216 LA SALLE STREET, CHICAGO.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

Electric Light Carbons

AND

BATTERY MATERIAL.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

LAVA INSULATORS.

ABSOLUTELY

Fire, Water and Acid Proof.

MADE FROM MODEL IN ANY SHAPE.

Have stood severest tests, can furnish highest testimonials from largest manufacturers of Electrical machinery in the world. Samples and estimates sent on application. Cheaper than any reliable insulation.

D. M. STEWARD M'F'G CO., Chattanooga, Tenn.

January 1st, 1888, we removed our entire plant from Cincinnati to Chattanooga, where we have greatly increased facilities in all departments.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

707 and 709 MARKET STREET, - ST. LOUIS.

BRANCH, 521 DELAWARE ST., KANSAS CITY.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

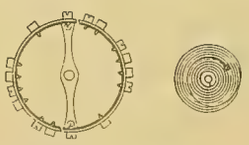
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**

These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

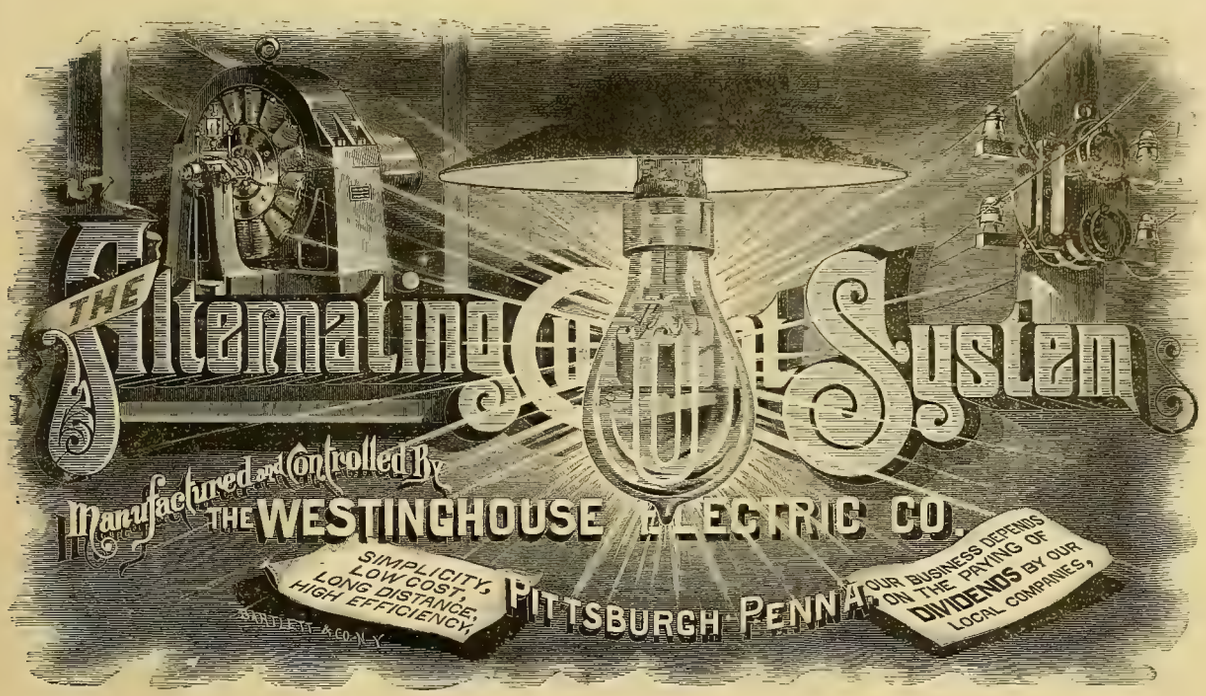
These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

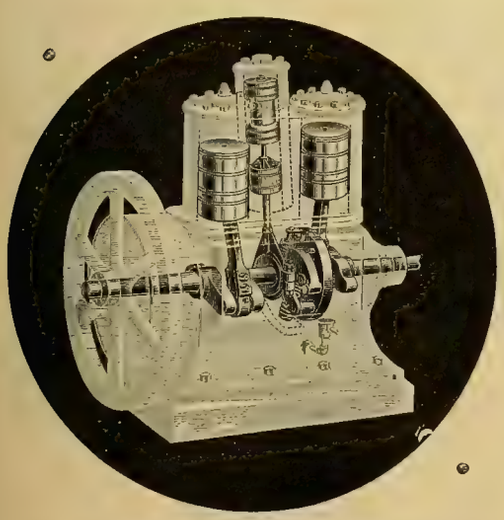
They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

For Sale by all First-class Jewelers.





The Single-Acting and Self-Lubricating Principles

Mark the second great advance in Steam Engineering, and represent the Highest type of

COMMERCIAL ECONOMY.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

SELLING DEPARTMENT
CONTROLLED BY

Westinghouse, Church, Kerr & Co.
17 Cortlandt Street.....New York.
97 Fifth Avenue.....Pittsburgh.
156 and 158 Lake Street.....Chicago.

Fairbanks & Co.
302 and 304 Washington Ave.....St. Louis.
1312 Union Avenue.....Kansas City
1330 Seventeenth Street.....Denver, Col.

Utah and Montana Machinery Co.
259 South Main Street.....Salt Lake.
East Granite Street.....Butte, Mont.

Parke & Lacy.
21 and 23 Fremont St.....San Francisco.
33 and 35 N. Front St....Portland, Or.

The D. A. Tompkins Co.
36 S. College St..Charlotte, N. C.
46 S. Pryor St.....Atlanta, Georgia.

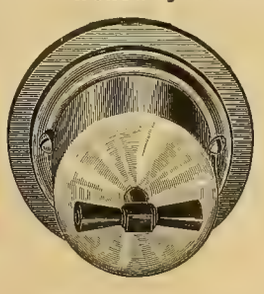
Our BELTING
is tanned on the surfaces only; the
INTERIOR is RAW HIDE.
Send for Our Valuable Book for Engineers and Belt Users. Free.
Agents in all Cities. Send for Trial Belt.
Our Belts are the strongest, most even and perfect Electric Belts made.
ST. LOUIS, MO.

Forest City Electric Works,

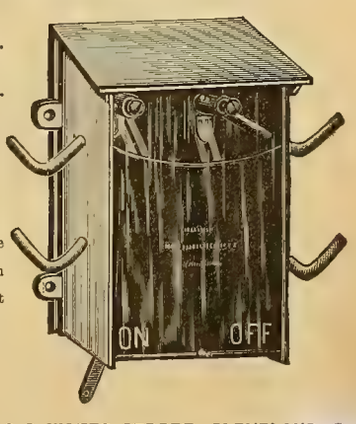
Manufacturers of CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.



Correspondence Solicited with Electric Light Companies.

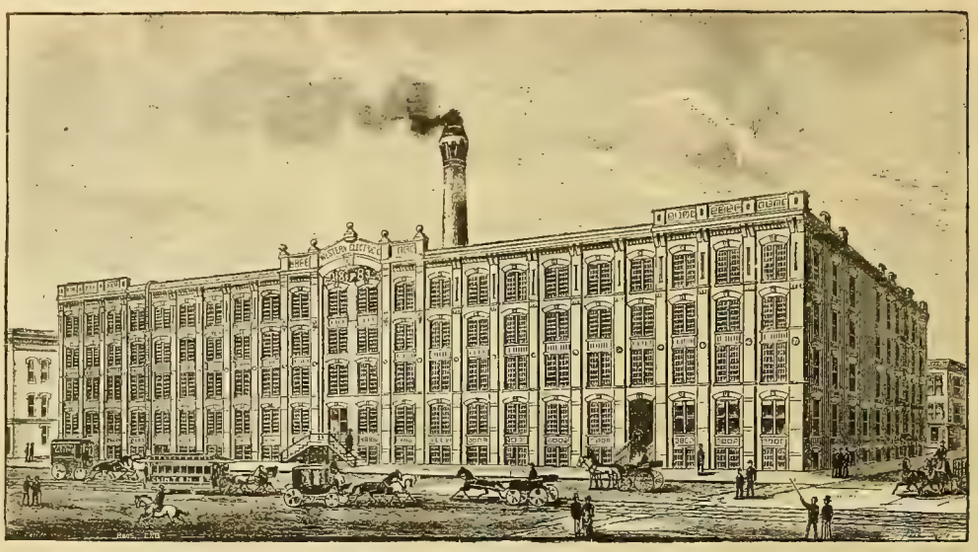


W. B. CLEVELAND, Proprietor, 26 S. WATER STREET, CLEVELAND, O.

WESTERN ELECTRIC COMPANY,

Chicago. London.

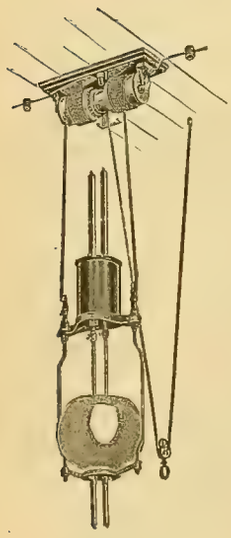
New York. Antwerp.

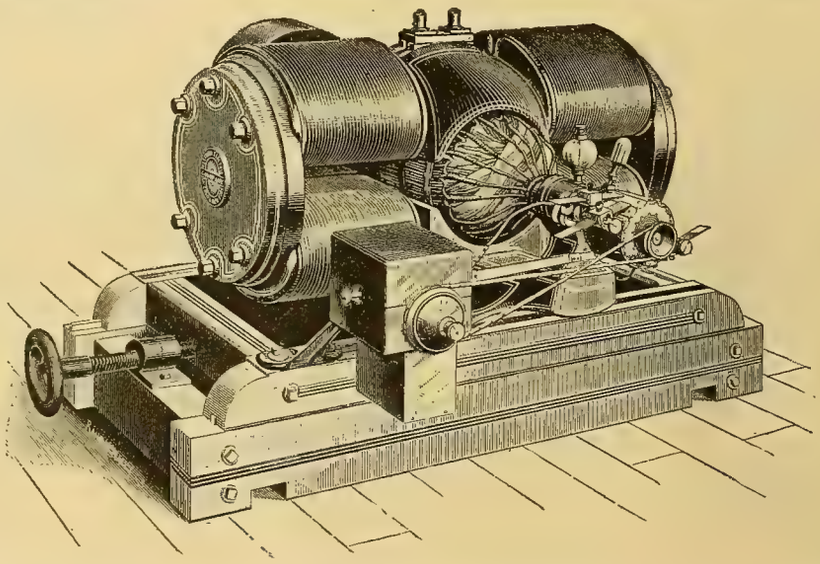


CHICAGO FACTORY.

Electric Lighting Apparatus

OUR SYSTEM OF ELECTRIC LIGHTING IS COMPLETE IN EVERY DETAIL, AND IS UNEXCELLED IN THE EFFICIENCY AND WORKMANSHIP OF THE APPARATUS, IN THE BRILLIANCY, STEADINESS AND COLOR OF THE LIGHT PRODUCED, AND IN AUTOMATIC REGULATION. WE FURNISH DYNAMOS TO GIVE ANY REQUIRED CURRENT. THE HIGH GRADE OF WORKMANSHIP AND THE EFFICIENCY OF OUR DYNAMOS





RENDER THEM SPECIALLY ADVANTAGEOUS FOR CHARGING STORAGE BATTERIES, FURNISHING CURRENT FOR ELECTRIC MOTORS, ETC. WE FURNISH ARC LAMPS ADAPTED TO ANY ARC CURRENT. THE SUPERIOR CONSTRUCTION AND SIMPLICITY OF OUR LAMP RENDER ITS USE ADVANTAGEOUS WITH ANY SYSTEM.

WE HAVE STILL A LARGE QUANTITY OF

KERITE WIRE,

Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even No. 16 gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes Nos. 13, 14, 15 and 16.

J. GEO. KAELBER, Selling Agent, 3 & 4 Duff Block, Denver, Colorado.

Western Electrician.

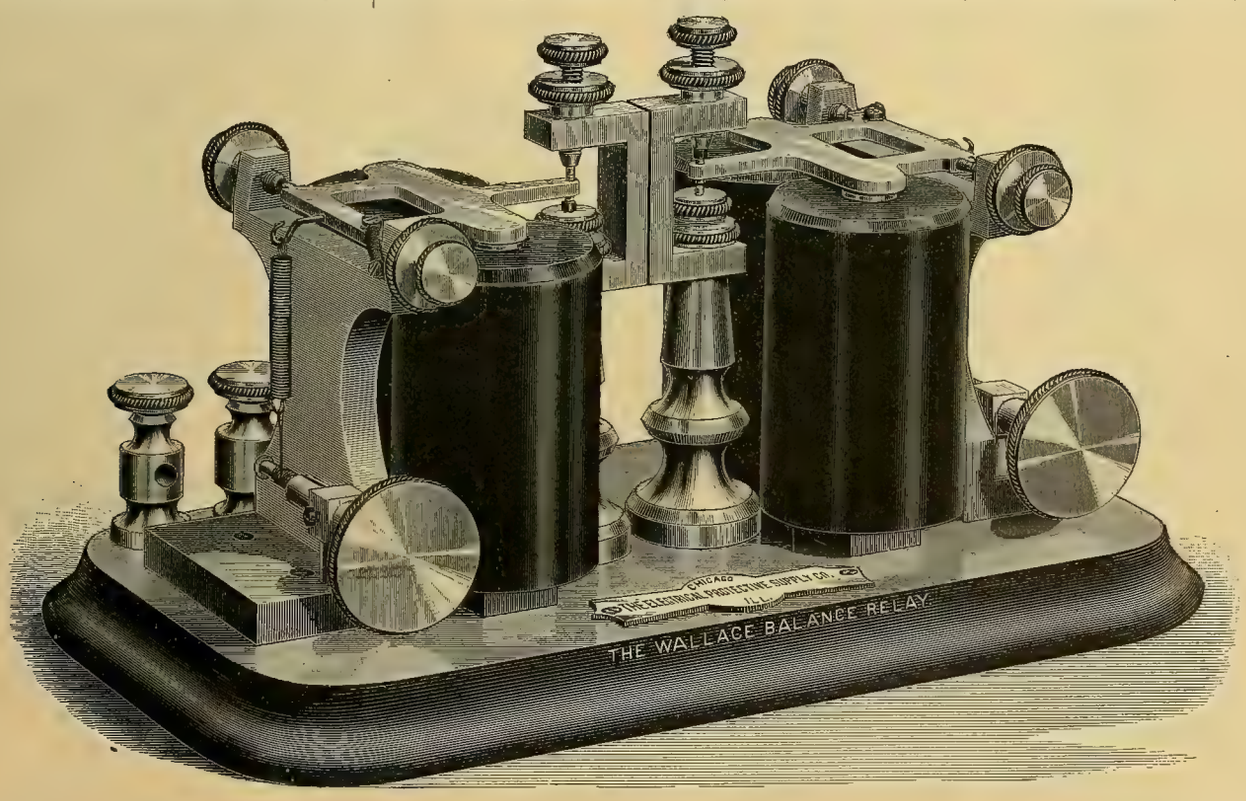
EVERY SATURDAY

Vol. II. CHICAGO, MARCH 3, 1888. No. 9.

The Wallace Balance Relay.

The handsome cut in connection represents the Wallace balance relay now being introduced by the Electrical Protective Supply Co. of Chicago. The principle involved is the adjustment of the relay so that the slightest variation in the resistance of the line opens or closes the local circuit. The instrument consists of two helices wound in series to any resistance required. Each helix has a separate armature, but each armature opens and closes the same circuit. One opens and the other closes the circuit when attracted by the magnets. When the current has passed through the helix, both armatures are attracted, but by tightening the adjustment spring of the right armature until it overcomes the power of the magnet the contact point presses against the insulated screw.

The instrument being adjusted for the resistance of the line, the local circuit will be open through the relay. If the main line is open, the left armature closes the local circuit. If the resistance of the line be diminished, the right magnet becomes strongest and closes the circuit through its armature. In this way the instrument can be balanced to indicate the slightest variation in the resistance of the line. It is very valuable in burglar alarm work, district telegraph and messenger service, or any place where sensitiveness or fine adjustment is required.



An Electrically Lighted Coupe.

A novel method of carriage lighting is shown by an installation of the Northwestern Electrical Accumulator company, at the salesrooms of Studebaker Bros., on Michigan avenue, Chicago. A coupe is furnished with lanterns, within which are attached incandescent lights of three candle power. The interior of the coupe is illuminated by three lamps of equal power. The arrangement at present only indicates the plan in the rough. The design is to locate the storage battery under the driver's box. At one side a switch will control the lantern lights. Similarly the lights on the interior are controlled by a switch within reach of the seat. The coachman by pressing with his foot a button on the foot-board can light the lamps on the interior, so that persons can readily see the way as they enter the carriage. It is proposed to use a battery which, with ordinary use, will require charging once in two weeks.

The Copper Market.

The indications are that the price of copper is to be still farther increased. It is generally believed that the French syndicate has obtained substantial control of the world's product and that it is preparing to apply the screws. In this connection the views of gentlemen connected with the copper trade in Chicago are of interest. In a conversation with a representative of the WESTERN ELECTRICIAN, George C. Bailey, of J. A. Roeblings' Sons & Co., said: "It is difficult to speak definitely on this question, and my opinion is based merely on what I have heard We do not look for any decrease in the price of copper, but on the contrary, we anticipate a rise, if there is any change. Copper for electrical purposes for the most part comes from the Lake Superior region. The fire in the Calumet & Hecla mine has decreased the product from that point one-half. You understand that the French syndicate controls the most of the copper. It has a capital of $250,000,000, so it wields a tremendous power. It forced a large number of the smaller holders to sell by lowering at one time the price of copper. When the price fell these timid holders thought it was the best policy to dispose of their copper before they lost by a further decline. Thus these small holdings were bought up, and the price was then advanced with safety. Knowing these facts I cannot see any probability for lower prices."

Said another gentleman interested in the sale of copper: "It is not an easy matter to make a prediction in reference to the copper trade. If I could state with a certainty just what the future would bring forth, I would put you in a way of making a million very handily. Every indication points to increase in price. However, the rate is not high in my opinion at present. The fact is, that the price of copper has been so low for the last few years, that the owners of the smaller mines could not afford to work them. If this syndicate has the large capital which report gives it, we may expect twenty cent copper for the next three years."

Death of George H. Corliss.

George H. Corliss, the engine builder, died February 21st at Providence, R. I., of paralysis of the heart. Mr. Corliss was born in Easton, N. Y. He never saw the inside of a machine shop until he was 25 years old. He went to Providence in 1844, and in 1846 began the development of his steam engine improvements, and in 1848 completed an engine which embodied the essential features of the present Corliss engine. He carried away the highest competitive prize at the Paris exhibition in 1867; was presented the Rumford medals in 1870, the late Dr. Asa Gray, president of the Academy, making the presentation, and won the grand diploma at the Vienna exhibition in 1873. On the strength of foreign builders who made exhibits claiming them to be of the Corliss type, he himself not being present or represented as having any exhibit, the Montyon prize for 1878 of the Institute of France was presented him. He has recently received other valuable medals from foreign societies. Mr. Corliss was a commissioner at the Centennial Exhibition, and his

engine for transmitting the power all over Machinery Hall added to his fame. The undertaking cost him $100,000.

Electric Currents in the Mouth.

At the meeting of the Chicago Dental society at the Tremont house Monday evening, Dr. Fernandez gave an interesting talk on the subject of amalgam fillings. The discussion of the topic led to the consideration of the advisability of placing in the teeth as filling more than one kind of metal. To illustrate his views on the question, Dr. Whitfield gave several experiments, repeating those which he presented at the last meeting of the Chicago Electric club. First he took a small piece of bone about the size of a tooth, into which he had drilled small cavities on each size, filling them perfectly, one with amalgam and the other with gold. When these metals were dry, the doctor explained, there was of course no electrical action excited. To this representation of a filled tooth wires had been attached. Immersing it in a tumbler of water, galvanic action was commenced, and was shown to exist by the deflection of the needle of a galvanometer, which was brought into the circuit with the wires. The doctor put the tooth in his mouth, and the moisture caused the flow of a current, the presence of which was indicated in the same way. This demonstrated to Dr. Whitfield the inadvisability of putting two fillings of different metals in the same tooth. He quoted from an article in a dental magazine in which it was stated that if the two fillings of different metals, but in the same tooth, were connected with each other, no electrical action followed, but it was dead. This statement was held by Dr. Whitfield to be untrue, and he demonstrated the correctness of his own position by another experiment in which he used a tooth containing a gold filling, in the center of which was a small amount of amalgam. The needle of the galvanometer moved appreciably when the tooth was placed in water, and the test for current was made. The only effect of joining the two metals in a tooth was to form a short circuit. The current was not destroyed. The doctor asserted that it made no difference whether the fillings of the two metals were in the same or in different teeth, the result would be the same, the generation of a current. The evil effect of this action in the mouth was this, oxygen was liberated at the gold filling. The tissue around it would become discolored and roughened, and the result would naturally be the destruction of the filling. This effect was shown by an experiment which the doctor said had been in progress for several days. He had placed a tooth filled with gold and another filled with amalgam in a glass tube filled with saliva. The discoloration around the gold filling, due to the liberation of oxygen by galvanic action, was noticeable. It was true that with some metals the galvanic action would not be so pronounced. With tin, for instance, instead of amalgam, oxidation would soon ensue and would, of course, decrease the generation of current. Dr. Whitfield's experiment created the greatest interest, and while he was making the tests, he was obliged to stop many times to answer questions.

Dr. Prime opened the discussion. He said he was greatly interested in the experiments and he thought from such investigations results of the highest importance to the dental profession might be accomplished. Theoretically, there was an electrical action between the two metals in the mouth, but as a matter of-fact he thought the current practically ceased as soon as the amalgam was oxidized. He thought that in most cases trouble was experienced because the filling was not properly put in.

Dr. Marshall said the experiments brought to his mind the investigations of Dr. Palmer of Syracuse, in the same direction. The latter had found that the action was caused not alone between two metals, but the same result was noticeable when certain kinds of food were brought together. For example Dr. Palmer had found that when turkey and cranberry sauce were brought together in the mouth, galvanic action was set up. The same was true when ham and eggs were eaten. In fact Dr. Palmer had found that the zest which certain combinations of food possessed was due entirely to the presence of an electric current. The same fact explained why water tasted better when drunk from a tin cup. Englishmen when they came to this country complained that American beer was of poor quality. The reason they did not like it was because it was not drunk in a pewter mug and no electric current was formed to give the beverage a peculiar zest. Another dentist started a laugh by saying green peas and veal always started electric action in his mouth, and the result was of a serious character as a swelling formed almost instantly on his neck. He attributed this unpleasant phenomenon to the presence of filling in his teeth.

Explosion in a Conduit.

In Chicago on Saturday last, one of the man-hole caps of the Chicago Arc Light & Power company's underground conduit on LaSalle street west of the city hall, blew off with a loud report and was hurled upwards to a height of about 20 feet. These caps are of cast iron and weigh about 80 pounds, and the damage to any passing vehicle and its occupants might have been serious, but fortunately no damage was done. Man-hole caps have been blown off several times before, and a year ago one of them went through a plate glass window of the Board of Trade building on Jackson street, creating a panic among the occupants. The cause seems to be the accumulation of gas from the adjoining street mains which seeps into the conduit through the soil, which, in the vicinity of those mains, is thoroughly impregnated with it; the application of a light at any remote point, where repairs were being made, or spontaneous combustion would ignite this gas, mixed with air, and produce the explosion. The conduits are water-tight and the man-hole covers fitted closely without ventilation, to exclude the street drainage; and when sealed still more closely by snow and ice the gas can not find an outlet, and such explosions are liable to occur. To remedy this the company proposes to ventilate the conduit by an opening connected with a steam air pump at the terminus.

The telegraph conduits, lying adjacent on the same streets, seem to be free from such accidents, and to the greater weight of their man-hole caps, 700 pounds, this has been attributed. The difference probably lies either in a different method of construction of the two conduits or in some effect produced by the large currents of the Arc Light & Power company's cables as compared with the small currents of the telegraph company's cables. A single electric spark at some defective spot would be sufficient to ignite the gas, and is not an improbable occurrence in a cable carrying an arc light current.

The Hannahs Elevated Railway.

The construction of this railway for which electricity is proposed as the motive power, will be readily understood from the accompanying illustrations.

It is a light, strong, ornamental, open structure, wholly of iron or steel, built over the centre of the street, on arched transverse girders supported on pillars located at the curb-stone, as shown in Figs. 1 and 2. These girders are placed 60 feet apart, and 14 feet above the level of the street, as shown in Fig. 2; and being entirely open, and remote from the side-walks and buildings, they are no obstruction to light or air, nor are they in the way of fire engines, ladders or hose.

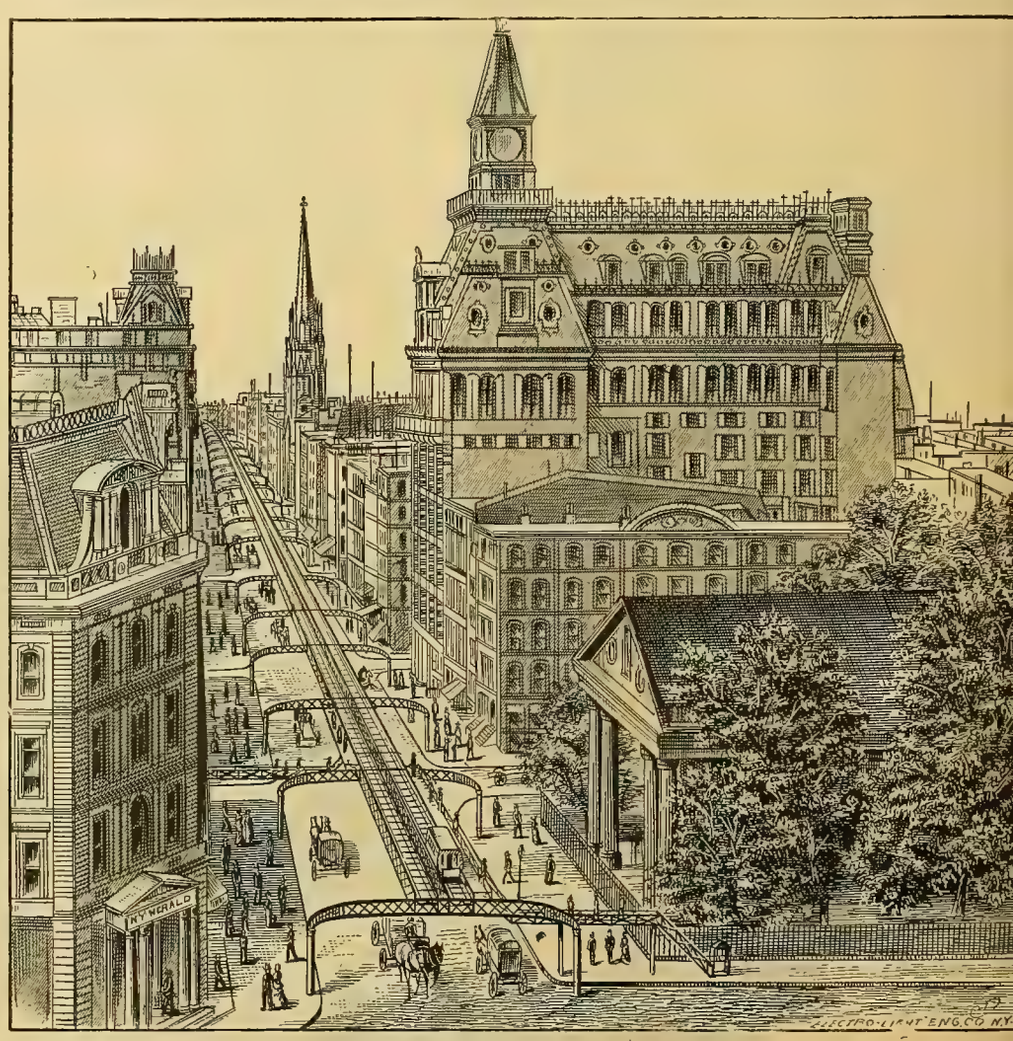


FIG. 1—THE HANNAHS ELEVATED RAILWAY.

This lightness and openness of structure combined with requisite strength are rendered possible by the method of operating the road with light single cars distributed at short intervals and propelled by electric motors, instead of heavy trains, at long intervals, drawn by steam locomotives. The advantages of this will be obvious when it is considered, that a train of three cars with locomotive, carrying 200 passengers, involves a weight of at least five times that of a single car with electric motor, carrying 30 or 40 passengers. This enormous weight of perhaps 25 tons, concentrated at a single point, requires at least five times the strength and massiveness of the structure on which the same weight is distributed in

ten cars at ten different points; and these single cars, half a minute apart, have an equal carrying capacity at the same time, since the weight of the ten motors does not probably exceed that of the locomotive. With the single car the weight necessary to produce the requisite friction between the wheels and track consists chiefly of passengers and is applied direct, while with the train it consists of inanimate matter drawing the train behind it.

The electricity is furnished either from insulated conductors laid between the rails, connecting with dynamos at the termini, or from accumulators placed on the cars. The motors are practically noiseless, and the continual roar of passing trains, belching out smoke, steam, sparks and cinders from the locomotives, setting fire to buildings, spoiling goods, and driving traffic and travel off the streets is entirely obviated.

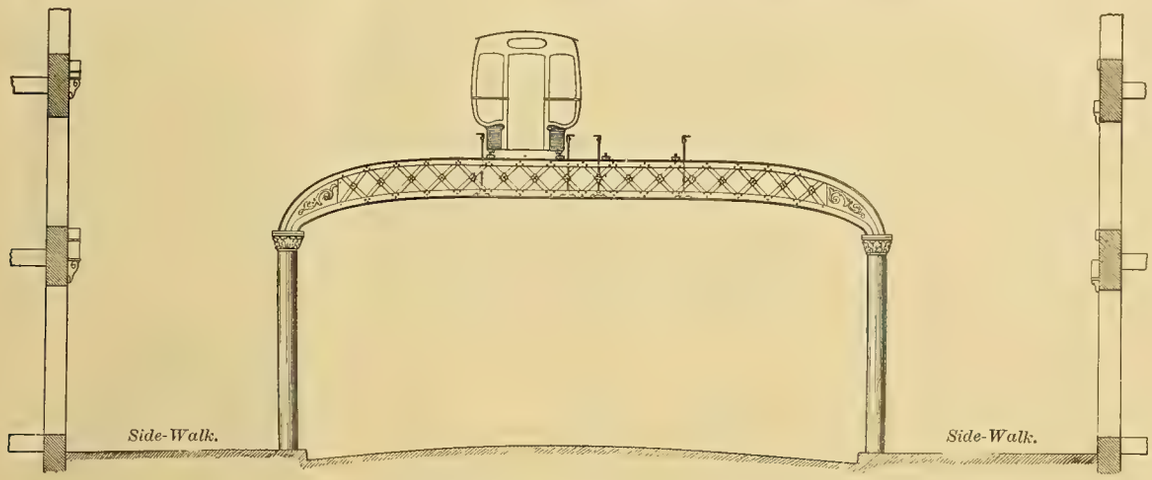


FIG. 2—THE HANNAHS ELEVATED RAILWAY.

Fig. 1 shows the stairways and platforms by which the cars are reached, and Fig. 3 the ornamental side structure which braces the track between the girders, and prevents cars from being precipitated to the ground in case of derailing. It is also proposed to light the cars by electricity derived from the same source which furnishes the power.

Prospects of Electricity as applied to Engineering.

At a recent meeting of the Institution of Civil Engineers in London, William Geipel read a paper on "Prospects of electricity as applied to engineering." In the introduction Mr. Geipel said: "On the other side of the Atlantic, although the science of electricity is much behind, the practice is far ahead of our own. European science has supplied an agent, the value of which has been recognized by American engineers; and now in the United States, the applications of electric motors are already rivalling, and will soon excel in importance, the application of electricity for lighting purposes. It is to be remembered, however, that there, owing to the high price of coal, the use of steam power is a more serious consideration than here; they have also in many places abundance of water power, which can be utilized by electric transmission. Notwithstanding these differences, there is in our own country an almost unlimited field for the employment of this mode of transmitting power cheaply to a distance, and of distributing power generated at a central station to a number of users in the neighborhood. Were it not for the cost of the dynamos and motors, electricity would supersede to a great extent the use of belts and shafting. In large works, where high speeds are required and the demand for power is variable, the efficiency of belts and shafting is very low indeed. As much as 25 per cent. of the power may be absorbed by the shafting when the full number of machines is in use; and in such a case, with half the machines in use, the loss of power rises to nearly 50 per cent., while in the extreme case of driving a single machine even 99 per cent. may be lost. With electricity, on the other hand, no power is being used in keeping the transmitting medium in motion, the conductor being stationary; the loss takes place only while power is actually being used by the motors, each of which drives its own machine. In fact, the percentage of power lost in the transmitting medium becomes smaller as the amount of power transmitted is reduced, which is exactly the converse of what happens with belting and shafting."

Coming to the question of the distribution of power, Mr. Geipel said: "The distribution of power by electricity from a central station to small users will, in the author's opinion, form in many towns a larger business than the lighting. Both can be done from the same mains and generators, just as is the case with gas; it is merely a question of economy and convenience as to whether gas or electricity should be used. The encouragement of small industries has long demanded some cheap means of obtaining power in small quantities, say from ½ horse power to 25 horse power. The gas engine has not altogether met the requirements of small establishments, although needing but little attendance; for the first cost of even a small engine is high, and the amount of gas consumed is large. Moreover, the speed is generally irregular, owing to the intermittent impulse, which is more especially noticeable with light loads; and a considerable amount of wear and tear takes place in the valves and working parts. An electric motor can be started and stopped at will with the greatest ease; it requires the smallest amount of attention, occupies the minimum of space, and can be placed in almost any position. An ordinary shunt wound motor will run at an almost constant speed, with a maximum variation of only 5 per cent., from running light to fully loaded. This exceedingly close regulation was obtained by using a simple shunt motor of suitable construction, and without any accessories such as the many forms of governing devices, to which so much attention had previously been devoted. The result shows that such a motor possesses a practically perfect power of self-control, not only over its rate of speed with varying load, but, what is of equal importance, over the energy absorbed by it; for it helps itself, as it were, to only such an amount of energy as will enable it to deal with the work imposed on it. Another advantage in the use of shunt motors is that they act as generators when themselves driven by any extraneous power, without any complication of switch gear, such as is required with a series motor. In such a system, where railways, lifts, etc., are being worked by motors, the current generated by descending trains or loads, might suffice at times to supply the rest of the motors with sufficient current for their work, without absorbing any current from the dynamo; at any rate it would reduce the amount of current required to be supplied by the dynamo. The first cost is also small compared with that of a gas engine. As small steam engines are being superseded by gas engines wherever the outlay for the latter can be afforded, the competition in regard to small power lies between gas and electricity, and steam may be left out of the question."

Mr. Geipel predicted that electricity would soon be largely employed in collieries for under-

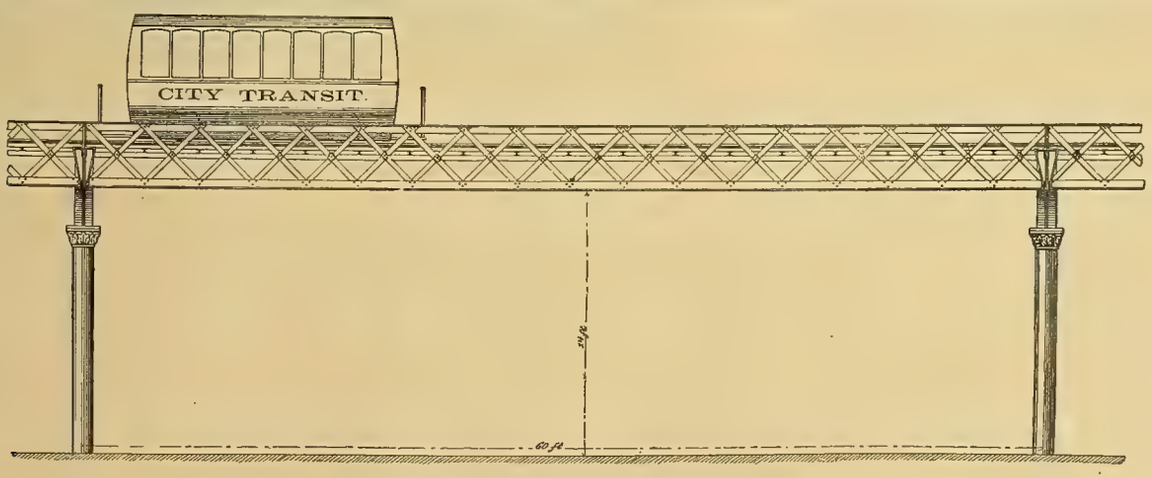


FIG. 3—THE HANNAHS ELEVATED RAILWAY.

ground hauling, pumping, ventilating and drilling, as it could be used with an efficiency double that of compressed air. He mentioned instances of the successful introduction of motors in shipyards, for drilling and riveting. Mr. Geipel referred to electric street cars, which he thought could be worked for 6 cents per car per mile, while with horse power the estimated cost ranged from 14 cents to 18 cents.

In the discussion which followed, Holroyd Smith objected to the speaker's statement that in America the practice and in England the science of electrical engineering are further ahead. He thought that both in science and practice the Americans led the way. An American would generally accept the first solution of a problem and carry it into effect without loss of time, whereas an Englishman would always seek for some better solution, and end by not doing the work at all. Another reason why electrical engineering is progressing much faster in America was the tolerance of the people towards new enterprises, which in England would meet with continual opposition on the score of unsightliness or inconvenience.

In referring to electric cars, Magnus Volk asked the mechanical engineers not to look upon electricity as though it were a rival, but rather to regard it as a useful adjunct to the forces which form the basis of engineering. Electrically propelled trains could climb steeper gradients than those drawn by a locomotive, and the cars on a downward slope would return power to the system to assist cars on the upward slope On his own line at Brighton, which is nearly a mile long, and contains some heavy gradients, the motors were put under the floor of the car, and the power was transmitted by leather link belts. The repairs were trifling. The first motor which began running, in April, 1884, had one set of new brushes after three years, and the life of a belt is about four years. He considered that 10 per cent. would cover depreciations, renewals, and repairs.

The Seel Incandescent Lamp.

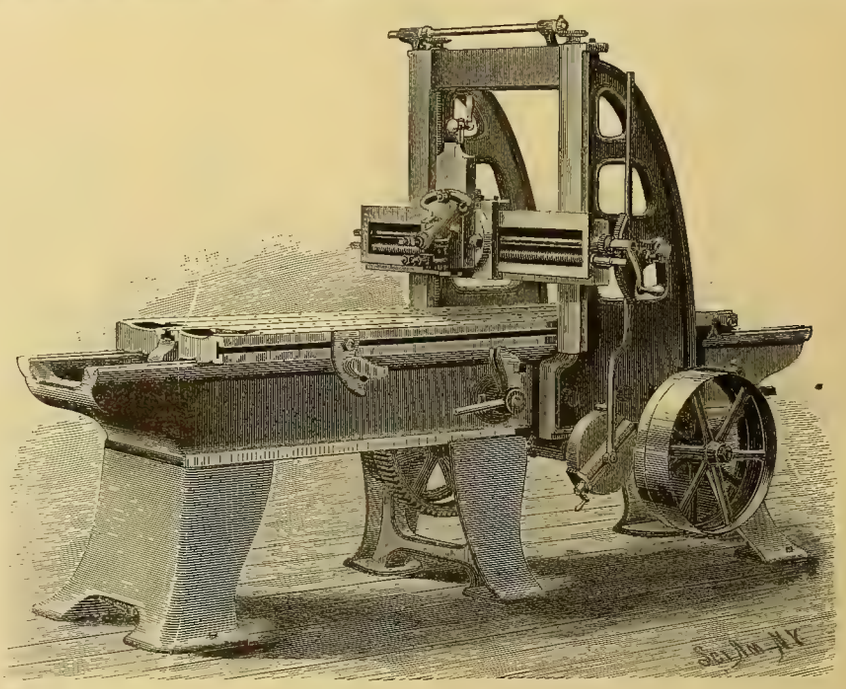
A new incandescent lamp, recently invented by Herr Seel, is being largely introduced in the Berlin installations. It is made either with a single or double filament, and of a power of from 8, 10, to 30 standard candles, but recently larger lamps, giving a light of from 200 to 300 standard candles, have been made. The voltage varies from 35 to 100 volts. The inventor claims that in small lamps the energy required per candle is about 3 watts, but in the 200 candle size only 2 watts. The pear-shaped globe, has no point in the centre, so that the light is freely emitted in all directions. The lamp is provided with a metal socket, into which it is cemented by plaster of paris, but the end face of the socket is protected by a disk of serpentine, through which the lamp wires pass. In this way the plaster of paris is prevented from absorbing moisture. The socket is fastened by a bayonet joint into a somewhat larger socket which is free to revolve on a plate, on the face of which are spring terminals of the branch wires, which are brought through the tube of the bracket. Two little studs, which are screwed into the serpentine plate, and are connected with the lamp terminals, form the contact with these springs when the holder is turned into a certain position. When the holder is turned 90° on its vertical axis this contact is interrupted, so that the light is switched on and off by turning the whole lamp with its holder on its axis. In order to avoid touching the lamp itself when switching on or off, the outer socket is provided with a slot, into which engages a pin on an arm, the prolongation of which is shaped into a handle of about the size used with an ordinary gas tap. By turning this handle the rotary movement in one or the other direction is imparted to the outer socket, and to make sure that even in careless hands the quarter turn should be fully completed, so that the contacts shall be either completely made or completely broken, the spindle of the tap is provided with a disk having flats, against which presses a spring. The filament is prepared from a vegetable or animal fibre, the exact nature of which the inventor keeps secret. In cross section the filament is triangular, and consists of three layers.

Major King's Monster Magnet.

Major King's immense magnet made of two great Rodman guns, mention of which has been made heretofore, has been subjected to very interesting experiments. A crowbar which was applied to the magnet required the combined force of four strong men to tear it away. A handful of pins thrown in the opposite direction immediately flew back and attached themselves to the magnet. A seemingly impossible experiment was performed with some fifteen-inch cannon balls. The balls were solid and as much as a strong man could lift, yet the magnet held several of them suspended in the air, one under the other. The most amusing experiment was made with a sledge hammer. When one tried to wield it in a direction opposite to the magnet he felt as though he were trying to hit a blow with a long feather in a gale of wind. There is nothing in the world that could take the conceit out of a strong man so much as this simple experiment. Another amazing test was made with a number of carpenter's spikes. A spike was put lengthwise on the end of the magnet, then another spike was attached to the first and so on until a line of them stood straight out from the magnet at least four feet in length.

A Planer for Dynamo Builders.

The general activity prevailing in the electrical department of industry has had a beneficial effect upon other departments and has resulted in a stimulation of energies to meet the varied needs peculiar to the former. For instance, the accompanying cut shows a new style of planer made by the L. W. Pond Machine company of Worcester, Mass., for dynamo builders. It is designed for the heaviest class of work and as a glance will show is made very strong and rigid in all fixed parts. The cut represents machines from 24 to 36 inches square, designed to plane from 4 to 14 feet long.



The beds are of unusual length in proportion to the length of the table, leaving but a small part of the table to overhang when planing the extreme length. The tables are extra heavy, the slides are of good width giving an extra wearing surface and have an oil channel cut the entire length for the purpose of keeping them perfectly lubricated, and keeping the parts from cutting on heavy work; there are three bolt slots planed the entire length of the table; the holes drilled and reamed for the purpose of packing or holding the work firmly in place. The posts or uprights are very heavy, with large breadth of base and firmly bolted to the bed, with a large additional steel pin nicely fitted to a drilled and reamed hole in both parts to make them doubly firm against a heavy lateral strain. The driving shafts are made of steel, fitted to extra long and large bearings, to give steadiness, smoothness, and solidity to the motion of the table when doing its heaviest work. The cross bar is strong and heavy, being well supported on the back with two heavy ribs or flanges, not shown in cut, is firmly bolted to the uprights, and can be quickly adjusted by the rise and fall screws, by hand on the small sizes and by power on the larger sizes. The slides and working parts are carefully scraped and fitted together, and are furnished with single or double heads. The feed is transmitted to the cross, down and angle screws through the driving shaft by a recently patented device, and runs perfectly free and loose after having done its work at the end of the stroke. The reversing motion is of recent invention, covered by patent, and can be easily adjusted to give either belt more or less lead to prevent an unpleasant squealing of the belts when the motion of the machine is reversed; it is entirely under the control of the operator at any part of the stroke, and prevents any unpleasant jar or jerk in reversing.

Practical Telephony.

By Thos. D. Lockwood.

Part VI.

We have now arrived at the point where we must examine the speaking and hearing instruments themselves. Everything that up to this point has been considered, is only of importance in its relation to the telephones.

Electric bells of all kinds are old and well-known, but not until the telephone was introduced did the magneto electric bell and the generator for working it, assume any consequence. So I am now going to say something about the telephone itself.

What is the electric speaking telephone?

Described in simple words, it is an instrument adapted to be connected with both ends of an electric conductor extended between two points distant from one another, by means of which words spoken at one point are, through the intermediation of electricity, audibly reproduced at the other. Therefore the telephone is not the receiving instrument only, or the transmitting instrument only, but is the complete organization of a transmitting and a receiving instrument united by an electrical conductor.

It is true that at the present time we employ not only a receiving, but also a transmitting instrument at both ends of the line; a little reflection however, will convince anyone that this involves no change in principle, but is only a matter of convenience. In practice we have become accustomed to colloquially term the magneto receiving instrument the "telephone;" and many persons having a higher regard for brevity than for correct terminology go so far, and take such liberties with this instrument as to call it the "'phone." I don't think this is because the time of these abbreviators is more valuable than that of others; but, because, in the first place, they have heard somebody else call it by such an

apology for a name, and wish to show to their fellow sinners that they are just as bold as any in thus flying in the face of Providence. Some persons are too old to reform their phraseology, but I recommend my young readers to get a habit of naming electrical appliances and terms correctly. In speaking as in doing, whatever is worth saying is worth saying well. And if, considering that the flesh is weak, it be found difficult or impossible to break from the "phone habit," then let us be consistent, and say "graph" if we mean "telegraph;" "gram" if we mean "telegram;" and "phant" if we are referring to "elephant."

Surely it is not necessary that I should state here that the black pedestal looking object with a cylindrical body which is attached by a flexible conducting cord to a pair of screw terminals on the bell box, and which when not actually in use hangs in the yoke or hook projecting from the side of the box is the instrument known as the receiving telephone. It is more; it is both a transmitting and a receiving telephone instrument. And because it is capable of doing this double duty it is justly entitled to precedence in description.

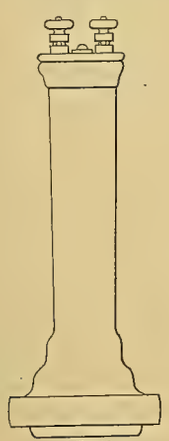


*Fig.*10

The case is made of hard rubber, no other material having been found so well adapted for the purpose. This material when old, and particularly if it has been exposed to the direct rays of the sunlight is disposed to assume an unpleasant olive green hue, but we will not quarrel with the looks of the instrument if it works well.

Fig. 10 shows in outline the general form of the magneto receiver, which for convenience will hereafter throughout this series of papers be termed the "hand telephone," or simply the "telephone."

A longitudinal section of this instrument is shown in Fig. 11 and correctly indicates its very simple internal arrangements. A permanent bar magnet, a soft iron pole piece fastened to one end of the magnet; a coil or helix of fine insulated wire surrounding the pole piece; and a plate of thin ferrotype iron together form the sum total of the essential parts. Let us however look a little closer, and notice the characteristics of each of these elements. Notice first the magnet; it is not a solid bar, but is made of four small flat bars each separately magnetized, and put together in pairs. The two on one side are placed close together, and the two on the other side are also paired, and care must be taken that in all four the poles are alike. That is, all the poles at each end must either be north or south. I knew a man not fourteen years since who was very zealous in his desire to learn all about the telephone, and his zeal in the present case compelled him to take a hand telephone apart. He put it together again, but it was speechless, and it was found that in recomposing the compound magnet he had turned two of the bars around, so that his magnet was absolutely neutral, two bars being neutralized by the other two which had their opposite poles at the same end. The soft iron pole piece has a flat extension which is placed between the two pairs of bars at one end, and a bolt is then passed through the magnets and pole piece which holds the latter in place. A similar but shorter pole piece is interposed between the magnets at the other end and is fastened in like manner. Why is the magnet so constructed? It is made from separate bars because it can be more easily and more perfectly magnetized when so made, and because it is found to hold its magnetism better. It is provided with a soft iron pole piece at its business end because soft iron magnetized inductively by proximity to or contact with a permanent magnet is found to be more sensitive to magnetic variation and more capable of responding rapidly, when anything tending to change its degree of magnetism occurs. The pole piece at the butt end has no special function except that it is provided with a threaded hole in its end into which passes a screw through the end of the casing which is formed of a small disk of hard rubber. The coil of insulated wire is fine and silk covered; is wound close to the core and has a resistance of about seventy-five ohms; it is intended to be connected directly in the line circuit, and for that purpose its ends are soldered to two larger insulated wires, which pass down through the case by the side of the magnet and connect with the inner end of two binding screws fixed to the rubber base plate. The binding screws are especially arranged to receive the tips of a flexible cord through which the line is reached. Notice that at the coil end, the case is flared and becomes larger to receive the coil; the edge of the flared extension is perfectly flat and serves as the diaphragm seat. The diaphragm is japanned on both sides for the purpose of preventing rust, and when at rest on its seat, does not or should not touch at its center, the pole piece end, but should maintain a distance of about one sixty-fourth of an inch from it.

Generally speaking the diaphragm center may be as close as it can be to the core without touching. Now observe the cap piece. This also is of hard rubber, and is fitted internally on its flange with a thread by which it may be screwed on to the flaring extension. The central orifice is not large, and just within the edge is a shoulder which, when the cap is screwed down, presses on the diaphragm edge holding the diaphragm in place. This shoulder looks like a small thing and a trivial detail, but it is really one of the most important features of the instrument, and without it, or an equivalent, the telephone would not work or would work very badly; the fact is that the presence of that shoulder forms, when the cap is screwed down, in connection with the outer surface of the diaphragm, a flat air chamber, which experience has demonstrated to be essential in the perfect transmission of speech. These elements comprise the hand telephone, and to those who wish to become thoroughly acquainted with it, those who are just making a start in telephony, I would say, "Don't be content to read the description, and to examine the pictures, but get hold of the instrument and look into it for yourselves."

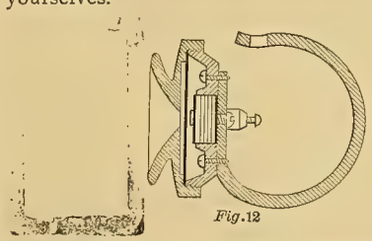


*Fig.*12

It will be remembered that it has been stated that although the hand telephone is now generally used as a receiver only, it is also quite capable of being employed as a transmitter. For a long time in the early history of the telephone there was no other transmitter, and even now there is one telephone exchange which has some three or four hundred subscribers, and which is worked altogether with magneto telephones. This is mentioned here, simply for the purpose of pointing out, that this property possessed by the magneto telephone of serving with equal facility in either capacity has in many places been quite overlooked and almost forgotten. It is however a most useful and valuable capacity, and often, as I propose hereafter to show, can be made available to advantage, in testing main circuits and communicating, when the transmitter is out of order by reason of some ailment of its local circuit. And a good magneto telephone I think could often be used profitably in small exchanges, where it would not pay to employ the battery transmitter. In many respects it would be superior; no battery is required in its use; it is therefore clean; it has no adjustments and therefore no temptation to get seriously out of order; it can perform the offices of both mouth and ear, and as the late Clerk Maxwell used to say, "it is one of the most complete things in the world theoretically, and at the same time one of the simplest—the electric wire, two instruments exactly alike, one at each end of the wire, and the two gossips, one at each instrument." I do not despair of a partial return to first principles, or of seeing within the next year or two a much more extensive use of the magneto principle in telephone transmitters.

You cannot often trace a fault to the hand telephone. The most frequent ones, are "weak magnetism," and loose connections, although with those which were made some time ago, troubles have been known to rise, owing to fragments of extraneous bodies such as filings, pieces of dried shellac varnish, or morsels of paraffine wax, which have dropped from the interior of the telephone case, and have found their way between the end of the pole piece and the diaphragm, thus impeding the vibrations of the latter. This fault can scarcely occur in telephones of late manufacture, as now neither shellac nor paraffine

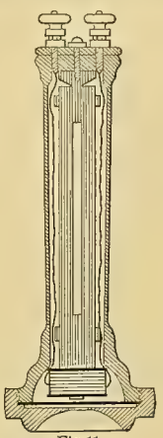


*Fig.*11

is used in the telephone cases, and a partition or screen is interposed between the cavity of the coil and the cylindrical portion of the case.

Loose connections are chiefly found at the flexible cord tips which will occasionally work loose at the screw posts. Only once in a very great while does anything of that kind occur in the body of the telephone, and it need not be ordinarily looked for.

Weakness in operation may of course be due to the disappearance of magnetism from the magnet; this occasionally may occur, from the accidental introduction of an inferior grade of steel, or the magnet may become demagnetized by lightning. I have known a few such cases. In either contingency the telephone should be at once returned. Telephones received from the factory should be closely examined by a proper person, and tested before putting out. The old axiom about the "ounce of prevention, etc.," fits well at this point.

A more frequent cause of trouble in the hand telephone is ill usage received at the hands of the subscriber. When the latter individual is of an inquisitive or amateurish turn of mind, he is likely enough to investigate the diaphragm with a brad-awl or a punch; and a bent or perforated diaphragm is not a friend in need.

You can easily find whether the magnet is weak by unscrewing the cap, removing the diaphragm and testing its strength with a good sized nail. At the factory they are tested to support their own weight, but will work well if very much weaker than that.

Quite often the cap is by some person or persons unknown screwed down too tightly; in this case also the talking is liable to be weak. Remedy: Unscrew a little; but a better way is to unscrew it until it is quite loose and then screw up again until you feel it settle snugly but not tightly upon the diaphragm.

A very successful form of hand telephone for some purposes, is the pony crown type represented in Fig. 12. The magnet is covered and serves as the handle, but as will be seen at a glance, the elements of principle and construction are identical.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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CORRESPONDENCE relating to electricity, or any of its practical applications is cordially invited, and the coöperation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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THE French Academy of Sciences offers a prize consisting of a medal of the value of 3,000 francs for the best essay upon the perfection in some important point of the theory of the application of electricity to the transmission of power.

IN another column will be found an article on "Electromotive force and difference of potential," by our esteemed correspondent, Professor Carhart, in which he assumes positions which will strike the average electrician as being rather anomalous, and calls in question the accuracy of certain fundamental propositions which are usually accepted as electrically orthodox; as for instance, that "e. m. f. and difference of potential are synomymous terms, or that e. m. f. is due to a difference of potential." In discussing this point he takes the ground "that a current does not always flow from the higher to the lower potential; it may even flow from the lower to the higher;" and instances in proof of this the battery circuit, in which, while admitting that "in the external circuit the current will flow from the positive to the negative, or from the region of higher potential to that of lower," he says "in the internal circuit the current flows from a region of lower potential to one of higher." Further on occurs the statement that "it is possible to have a circuit through which a current is flowing without any difference of potential in it;" in support of which he adduces the case of an electric current induced in a coil by the insertion of a bar magnet.

The professor is a bold swimmer in the electric current, and may be able to demonstrate his ability to swim against the current as well as with it, or if not against the actual current itself, at least against the current of ordinary electrical opinion.

ARE certain combinations of food productive of more gustatory pleasure than others because they excite an electric current which stimulates the mucous membrane and tickles the palate? Dr. Marshall, who is learned in dental science, at the last meeting of the Chicago Dental society, referred to a series of interesting experiments which would seem to indicate the necessity of answering the query in the affirmative. He mentioned the fact that Dr. S. B. Palmer, of Syracuse, several years ago, resolved to investigate the reason why ham and eggs when brought into combination formed such an unexpectedly relishable compound, why turkey was always more palatable when eaten with cranberry sauce, why apple sauce formed a necessary adjunct to roast pork, and so on. In investigating this curious problem Dr. Palmer came to the conclusion that the existence of an electric current might afford an explanation. He obtained a galvanometer of the most delicate character for the purpose of making the experiment. Taking a small bit of turkey he covered it with the most appropriate sauce and after moistening the combination made the test. Sure enough the needle was deflected. The same result followed when other popular combinations of food were tested. Here is a new field for investigation! It would be an interesting fact if it could be demonstrated that the relish of an article of food varied directly in proportion to the amount of electric current which it possessed the power to excite in the mouth. An opportunity to investigators might then be afforded of discovering some means of imparting to every kind of food a power of exciting a gustatory pleasure. The dyspeptic, condemned to eat the plainest food, might then enjoy a highly flavored meal without incurring the danger of suffering on the morrow the pangs of an outraged stomach. The poor could eat as highly seasoned food as the rich; in fine, the applications of such an invention could not be foreseen and its economic significance could not be estimated.

THE London *Electrician* is disgusted with the report of the New York commission, favoring the execution of criminals, condemned to death, by an electric current. It says: "A commission, we are told, has pronounced its award in favor of the electrical method; and we have no choice but to accept the statement. But when it is added that various plans for applying the electric current have been proposed by rival engineers, we take leave to doubt it. That electrical engineers may be hard pressed for business, even in New York, is conceivable; but that they have entered into competition with Jack Ketch and Judge Lynch, we refuse to believe. If society has grown too squeamish to avenge itself on its enemies in the old-fashioned way, science, we feel confident, will decline to do the dirty work for it. We protest especially, against associating electricity with this revolting business. What would be said of us if we suggested poisoning the culprit with gas? Mr. Edison, we are pleased to notice since writing the foregoing, has expressed his detestation of the whole affair."

The tendency of the age has been to reduce the infliction of the death penalty to the minimum, and to adopt the most merciful method. Murder and treason alone are capital offenses in the United States, and at least practically so in other civilized countries. The rope and the guillotine have superseded the ax and the stake. If the death penalty is still a necessity it is false delicacy for science to be so "squeamish" as to refuse its aid. The social position of the American sheriff is certainly equal to that of the electric engineer; and his feelings should be respected in the performance of his duty, whatever may be thought of extending humane treatment to the criminal. Mr. Edison's objection is not to the electric method in particular, but to the infliction of the death penalty by any method. If it is "dirty, revolting business," as our cotemporary suggests, then let society abandon it, and if murderers can be persuaded to abandon their revolting business the necessity of any punishment will cease; but so long as crime prevails, society must protect itself and must employ officers with humane feelings to perform this work; and the difference aesthetically between incarcerating a man and taking his life is only one of degree.

Science must not shrink from the performance of any duty made necessary by the requirements of society.

THE proceedings of the electric light convention, published in our last issue, are as usual very interesting to electricians. The papers read on those occasions are prepared with great care, and are from leading practical men, and full of the results of practical experience. No one can afford to pass over this report superficially, or lay it aside as dull, dry, and uninteresting. The discussion of electric light topics necessarily involves that of a large number of kindred subjects embracing the whole range of electric science. This was shown in the discussion of the electric lighting of ships where the question of the influence of heavy electric currents on the compass needle was involved, which brought out some very interesting facts in regard to the construction of compasses, especially those used in the navy and on large ocean steamers.

Then the influence of such currents on watches and the proper means of protecting them led to the introduction of Dr. Lange's paper, and the witty remarks of Dr. Moses, who never speaks without saying something witty, interesting, and highly instructive.

The discussion of the revision of the patent law and the report of the committee on that subject brought an earnest protest from Mr. Leggett, who deprecated any interference with the present law, which he pronounced a very excellent one, lest it should result in loss instead of gain to patentees and to the public. Mr. Steuart, speaking for the committee, agreed in the view taken of the excellence of the law, and claimed that the object was to simply improve one or two important points, which would make the administration of the law more effective and more fully protect the rights of inventors and others.

Professor Thomson in his paper on insulation and installation of wires and construction of plant, spoke particularly of the importance of more system in the installation of aerial lines, especially where the wires are numerous, not only to avoid the unsightly appearance, but to prevent accident and leakage from contacts. On this point he recommended that wires of all kinds be hung in orderly bundles having a definite direction and changing that direction only by definite angles in accordance with a prearranged system.

In regard to the insulating covering of wires he spoke of the difficulty of finding a covering which is both moisture proof and fire proof, as the two properties seem in most cases to be incompatible.

The frequent allusions during the convention to the alternating current by different speakers, show an increasing interest in regard to it.

Some interesting facts in regard to underground lines were brought out in the discussion; various instances being given of injury to wires which were apparently safely laid in conduits, from the jarring and concussion of trains and heavy teaming on the surface in close proximity; this often results, as was shown, in the abrasion of the insulating coverings, and in leaks admitting water and sand, resulting in the destruction of the insulating envelope. Instances were given of lead covered cables becoming indented and abraded, resulting in burning out.

A practical paper on belting was presented by Chas. A. Schieren, reviewing the manufacture of belts and the various improvements in the treatment of leather and other materials, especially with regard to belts required for dynamos.

Dr. Liebig's mathematical paper on motors and their theoretical construction brought out some interesting practical facts and figures by Mr. Harding of New York.

The steam engine in its application as a generator of electricity in incandescent lighting, was the subject of an able paper of considerable length, by W. Lee Church; and the economic value of steam pressure records, was the subject of a paper by J. B. Edson.

S. E. Barton's paper on the relation of electric light to fire insurance showed that in four of the New England states, embracing the territory of the New England insurance exchange, it has been found that the introduction of the electric light had greatly diminished the fire risk, and that it is possible with proper safeguards to reduce it to the minimum, while quite impossible to do so with any other means of artificial lighting. Electric lamps and conductors can be protected, while oil lamps and gas jets can not be adequately protected. This insurance company is now prepared to issue policies at reduced rates to parties using the electric light.

G. W. Parker's paper on arc light carbons gave much interesting information on the various requirements necessary to adapt carbons to the necessities of arc lighting, especially with regard to the degrees of hardness and conductivity required.

The papers of T. C. Smith and O. B. Shallenberger on alternating currents are among the most important presented to the convention, this system being pronounced by Mr. Smith the greatest achievement of the age. W. W. Leggett and J. M. Smith read very interesting papers on underground conduits and conductors.

Electromotive Force and Difference of Potential.

By Prof. H. S. Carhart.

The statement is not infrequently made that the e. m. f. of any part of a circuit is equal to the difference of potentials between the two extremities of the part considered; and a still broader statement is sometimes met with, to the effect that e. m. f. and difference of potential are synonymous terms, or even that e. m. f. is due to a difference of potentials. So far are these statements from the truth that it is not even correct to say, that when a difference of potentials exists between two points, that difference equals the e. m. f. The propositions are true only within certain limits, and a closer analysis is necessary in order to discover the exact relations between the two terms. Daniell, in his "Text Book of the Principles of Physics," has adopted the complex expression "electromotive difference of potential" for e. m. f., but happily no one appears to have accepted the innovation, not merely because of its clumsiness, but because of its inexactness. A cursory examination of any circuit containing a source of e. m. f. will serve to discover that a current does not always flow from the higher to the lower potential. It may even flow from the lower to the higher. So also the very useful law that the fall of potential in different parts of a circuit is proportional to the resistances passed over must be applied with some caution.

Let us take a simple battery circuit and analyze it; and let us distinguish between two parts of the circuit, the external and the internal; further, let the whole e. m. f. of the circuit have its origin somewhere within or along the internal circuit, so that the external circuit is not the seat of any e. m. f. Then in the external circuit the current will flow from the positive pole to the negative, or from the region of higher potential to that of lower; the potential difference between any two points will be equal to the e. m. f. producing a current between those points; and the fall of potential will be proportional to the resistance passed over. But in the internal circuit the current flows from a region of lower potential to one of higher; the rise of potential is not in proportion to the resistance passed over, because it probably occurs by leaps instead of gradually, and the difference of potentials is not the e. m. f. acting in this part of the circuit. Much the same statements might be made of the external circuit of a dynamo machine, including the field and the armature. In other words, the ordinary propositions are true only when no source of e. m. f. is included in the region considered. It is possible even to have a circuit through which a current is flowing without any difference of potential in it, as was stated recently by Professor Anthony in his Franklin institute lecture.

In every case it is true, I think, that there is a loss of potential or electric pressure proportional to the resistance passed over in any portion of a closed circuit. Thus when a battery circuit is open, the potential difference between the terminals equals the e. m. f., but when the circuit is closed, the potential difference between the poles of the battery is less than the total e. m. f. by the loss in passing over the internal resistance. One method—the condenser method—of measuring internal resistance is founded on this fact, so that in passing from the zinc through the battery to the other terminal, the rise in potential is not so great as if the internal resistance were zero. The potential difference between the terminals of what we have called the internal resistance, is then less than the e. m. f. of the battery by the loss of potential in passing over the internal resistance; or, the total e. m. f. is to the entire resistance in circuit, as the potential difference between the poles is to the external resistance. The same statements apply to the external circuit and the armature of a dynamo. The potential difference between the brushes is always less than the total e. m. f. generated by the loss in traversing the armature; so that while the current travels through the armature from a lower to a higher potential, this up grade is diminished by the fact of resistance in the armature, and becomes less and less as the ratio of the armature resistance to that of the remainder of the circuit increases. If the external resistance becomes zero, the grade reduces to a level and no difference of potential between the terminals of the armature remains.

We shall now perhaps be better able to analyze and understand the case of a current due to an e. m. f., which is always necessary, but without any difference of potential. Let us suppose a circular conductor, and a bar magnet thrust forward south end foremost along the axis of the circle; and consider what takes place when the south pole reaches the plane of the ring. The lines of force radiate equally in all directions, cutting all parts of the ring in precisely the same way. An e. m. f. is accordingly generated, causing a current to flow round in the direction of watch hands, without any difference of potential between the different portions of the circle so that the current flows neither from lower to higher nor from higher to lower potential. In this case the e. m. f. between any two points on the circle depends simply on the number of lines of force cut per unit of time, and not at all on any difference of potential. The resistance here is entirely internal; and the loss of potential in passing over any portion of the ring, due to its resistance, equals the gain due to the induction, provided the resistance of every portion of the wire is proportional to its length. In this case, even the fall of potential is proportional to the resistance passed over, but this loss is constantly made good by the e. m. f. generated in the same part of the circuit. That this is so may be made evident in several ways. Suppose the ring cut at some point and an external circuit attached in such manner as not to be cut by any lines of force from the magnet. Then there will be a difference of potential between the two divided ends of the ring, which will bear to the whole e. m. f. the same ratio that the external resistance added bears to the total resistance of the circuit. In other words, the loss of potential now s partly in the ring and partly in the external circuit, while the entire gain is made in the ring; hence an outstanding difference of potential between the ends of the cut ring. Or, suppose a circuit made by attaching the ends of a conductor to any two points of the ring. Then a current will flow through this external circuit or there will be a di vided circuit between the two points of attachment on the ring; hence a difference of potential exists between those two points, because the loss of potential in passing by the double circuit, from one point to the other, is less than the gain due to the induction in that part of the ring. Or, further, suppose a portion of the ring, a quarter, for instance, to be of smaller resistance than the other three quarters. Then there will be a difference of potential between the ends of this quarter. If we call the e. f. m. generated in each quarter E, and the resistances of the one quarter and the three quarters R and 3 R^1 respectively, then by Ohm's law, $C = \frac{4E}{R+3R^1}$. If now R and R^1 were equal, we should have $C = \frac{E}{R}$; but in the quarter of lower resistance $\frac{E}{R}$ is greater than C because R is less than one quarter of the whole resistance. It follows that the effective e. m. f. producing a flow in that part of the ring is less than the whole e. m. f. generated in that quarter, since the current is the same in all parts, and Ohm's law must apply to every part. The difference between the generated e. f. m. and the effective is due to the fact that the loss of potential in passing over this quarter is less than the gain due to induction. Hence a potential difference exists between the extremities of the quarter.

We may then divide the circuit into two regions; throughout the one there is no source of e. m. f., and the other is the region where the force is applied which produces the electric flow or electric pressure.

In the first region, the difference of potential between any two points is equal to the e. m. f. producing a flow through that part of the circuit. Such a region must always show differences of potential from point to point.

In the second region, the difference of potential is not equal to the e. m. f., and the relation between the two will depend upon the relation subsisting between the resistances of the two regions. The second region does not necessarily nor usually show changes of potential proportional to the resistances passed over; and, as we have seen, there may be no difference of potential while there is, at the same time, an e. m. f. producing a current in a closed circuit.

In all cases, however, there is a loss of potential in a closed circuit proportional to the resistance traversed; and the value of the current is always equal to this loss of potential, divided by the resistance — a generalized statement of Ohm's law.

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number xxxi.

The Lane-Fox Carbons.—In the manufacture of the Lane-Fox carbons the raw material is obtained from the bass broom, a species of grass fibre. The hard outer surface is removed by immersion in a solution of hot caustic soda or potash and subsequent scraping, after which the alkali is removed with boiling water, and the fibers, in lots of about 100, bound to blocks of plumbago shaped so as to give them the horse-shoe form. These blocks, in lots of 50, are imbedded in powdered charcoal in plumbago crucibles, placed in a furnace and subjected for twenty minutes to a white heat. The fibers after being carbonized in this manner are gauged and sorted, and all of the same diameter placed together, after which they are suspended separately from spring clips by attachment at the ends, in large globes filled with a hydro-carbon gas obtained from benzole or coal, and subjected to the process termed flashing, first proposed by Sawyer. This process consists in rendering the filaments incandescent, either by the passage of an electric current or by the heat of a furnace, the latter being the method adopted in the Lane-Fox process. The gas in contact with each filament being decomposed, a layer of hard carbon is deposited which renders the filament denser, smoother, more homogeneous, more durable and more uniform in size; the smaller parts becoming hotter than the larger and thus acquiring a thicker deposit. The increased diameter reduces the resistance and the process is continued till the resistance required for lamps of a given candle power, ranging from 16 to 60, is obtained.

The Cruto Carbons.—These are made by using as a base a fine platinum wire bent into the horse shoe form, upon which the carbon is deposited by the flashing process. This is effected by attaching the wires, placed in a long glass vessel, to insulated metallic supports, by which an electric current can be sent through each of them. A current of olefiant gas $C_2 H_4$, circulates through this vessel, the gas being made from alcohol and sulphuric acid, purified by passing through water and lime water, and dried by calcium chloride and sulphuric acid, thus furnishing a gas of pure hydro-carbon. The platinum wires are connected with a shunt circuit so that an electric current passing through them can be graduated to any required strength by a resistance varying from one ohm to 200 ohms. The wire being heated to incandescence in this manner the gas is decomposed, and carbon deposited. To insure a uniform deposit it is necessary to guard against the influence of the earth's magnetism by placing the wires in a plane at right angles to that indicated by the dip of the magnetic needle; and in the latter part of the process the current is reversed. This operation, which requires about two and a half hours, produces a filament remarkably compact and homogeneous, and uniform in cross-section and resistance. Special care is required to maintain uniformity in the successive stages of the process, otherwise the result is a filament of dissimilar superimposed layers of carbon, lacking homogeneity, and practically worthless.

The Swan Carbons.—These carbons are made from cotton twine, prepared by immersion in sulphuric acid diluted with one third part water, by which they attain a consistence similar to that of parchment; they are then thoroughly washed to remove the acid, reduced to a uniform cross-section by being passed through disks, after which they are wound on rods of carbon or earthen ware, each in the form of a flat spiral having one convolution, and carbonized by being imbedded in powdered charcoal in a crucible raised to

a white heat. They are subsequently coated with carbon by the flashing process, and like the Edison carbons, heated and cooled alternately by the electric current to remove the occluded gases, while inclosed in the globe during its exhaustion. Each filament when finished is five inches long and .005 of an inch in diameter.

THE WESTON CARBONS.—The raw material used for these carbons is cotton or linen cellulose, which by the action of nitric and sulphuric acids is converted into nitro-cellulose—gun-cotton—which is subsequently dissolved in a mixture of alcohol and ether and converted into collodion, and finally has its combustibility reduced by the action of ammonium hydro sulphide or other chemical agent producing a similar effect.

This artificial product, which Weston calls "Tamadine," is an amber-colored, amorphous cellulose of great ductility, tenacity, and homogeneousness. It is rolled into thin sheets between steel rollers, and filaments of the sizes required for lamps of different candle power are cut from the edge of the sheet, bent on shapes into the horse-shoe form, carbonized in the usual manner, and flashed in hydro-carbon gas by the electric process. The carbons when finished are highly elastic, and have a smooth brilliant surface like that of a steel watch spring.

Origin and Growth of the Thomson-Houston Company.

The following from *Modern Light and Heat*, illustrative of the origin and growth of the Thomson-Houston Electric company, is interesting as an illustration of the rapid advance of electric lighting in general and the demands which this great industry is making upon our largest manufacturing concerns :

In the year 1874, while teaching at the Central high school of Philadelphia, the attention of Professors Elihu Thomson and Edwin J. Houston was directed to the construction of apparatus for electric lighting. Beginning then, in connection with their teaching and laboratory work, they continued for some time the development of various forms and designs of dynamos and lamps ; and it is interesting to know that by 1876 Professor Thomson had built a machine, the mechanical work on which he performed personally, which would operate an arc light in a very satisfactory manner. This machine had the three-coil armature and many of the component parts of the present Thomson-Houston dynamo. The equipments were extended, the professors laboring to apply theory to practice, and much new apparatus was constructed ; the next machine being one designed to run four lamps for a bakery in Philadelphia. This dynamo, on being tested, proved to be capable of operating twice the number of lamps it was made for. The performance of the machine attracted the notice of George S. Garrett, a citizen of Philadelphia, who, after thoroughly investigating the system, made arrangements with Messrs. Thomson and Houston to manufacture and handle the apparatus of their invention. Accordingly the negotiations were completed, and during the years 1878 and 1879 several similar machines were manufactured and sold.

The call for goods soon became so pressing that Mr. Garrett found himself financially unable to carry on the manufacure on such a plan as would enable orders to be filled with promptness, and sold a portion of his rights to a company which was organized in New Britain, Conn., to manufacture the goods of the Thomson-Houston system, and control all territory outside of New Jersey, Pennsylvania, Delaware, and Maryland ; that being held by Mr. Garrett for goods of his own manufacture.

Professor Thomson now gave up his chair at the Central high school, and moved to New Britain, and devoted himself entirely to the development of the apparatus and details for a complete and successful system of electric lighting.

The facilities there were not very great, the production being limited to about three dynamos and some fifty lamps per week. The work of the years 1880 and 1881 was not so great as had been anticipated, mainly because the management did not seem to realize the vast importance of the system they were handling nor the breadth of the field before them. In 1882 Messrs. S. A. Barton, C. A. Coffin, and other citizens of Lynn, Mass., succeeded in purchasing a controlling interest in the stock of the company, upon obtaining which they proceeded to make arrangements for radical changes in the company. The name of The Thomson-Houston Electric company was adopted, and the manufacturing was removed to Lynn, where a new factory, a hundred and four by a hundred and twenty feet, with three stories and basement, was being erected ; the old plant in New Britain being operated until about the end of the year 1883, when the removal took place, most of the men employed by the company coming to Lynn.

The business at once began to assume larger proportions. Owing to recent improvements, and to the push and enterprise of the new management, the growth and extension of the company's interests became phenomenal. During the first fifteen months, under the new management, there were established thirty-one local lighting companies, operating over twenty-five hundred lights.

In 1885 the Thomson-Houston company began to develop the incandescent system under the fundamental lamp patents of Messrs. Sawyer and Man ; and in connection with this, Professor Thomson extended his experiments with the incandescent dynamo. His invention of the inclined series coil is considered one of the most ingenious arrangements of series field winding known. This form differs from the well known compound winding in that the coil traversed by the main current is inclined from a perpendicular in a direction opposite to that of the rotation of the armature, and by its influence the neutral points is kept constant under great variation of load.

The development of the arc lamp was also progressing. A pupil of Professor Thomson at the Philadelphia High School, who had shown great talent in electrical matters, had been placed in charge of the factory. This was the present superintendent, E. W. Rice, jr., who, in company with Professor Thomson, had greatly modified the form and mechanism of the lamp.

All these improvements brought business, and it was soon found that even their new factory, with its two hundred horse-power engine capacity and five hundred hands, was not sufficient for the manufacture of the apparatus needed, and continuous running was resorted to. This did very well for a while ; but again the need of more room was felt, and in 1887 ground was broken for another and still larger factory, which, with a large storehouse, has just been completed.

On Oct. 3, 1887, the combination of the interests of the Thomson-Houston and Westinghouse companies was made public. This was brought about by the recognition by the Thomson-Houston company of the Gaulard and Gibbs patent on transforming and converting devices in connection with the alternating current system, and by the Westinghouse company of the Thomson-Houston patents covering its system of arc lighting, and the Saywer-Man patents on the manufacture of incandescent lamps. Mutual concessions were made, and the alternating business was divided,—the Thomson-Houston company controlling New England and some two hundred cities outside, and the Westinghouse company the remainder of the United States, arranging, when combination plants were installed, to use the Thomson-Houston arc system, and being licensed to manufacture incandescent lamps. This combination, assuring as it did to the users of the alternating system perfect immunity from adverse patent suits, had the effect of increasing immensely the Thomson-Houston business ; and it was for the manufacture of alternating apparatus, together with electric motors, that this new factory was erected.

It is a large three-story building, with engine and boiler house on one side, containing a five hundred horse-power Greene engine, and a battery of boilers set with the Jarvis furnace. The first floor of the building is devoted exclusively to the manufacture of motors, both for stationary and railroad use. The two floors above are used for alternating current dynamos, transformers, lightning arresters, and the parts and details of the apparatus for the new system.

The complete plant now comprises three factories and two storehouses in Lynn, having an aggregate floor space of over three acres, and covering an immense block. Engines of twelve hundred horse power capacity are used, and over one thousand men and two hundred women are employed. Artificial light is furnished by two hundred and seventy-five arc and twelve hundred incandescent lamps, and the output is somewhat over forty machines, six hundred arc lamps, and eight thousand incandescent lamps a week. The business done in 1887 compared with that of former years shows a marked increase. The thirty-one companies organized during the first year and a quarter do not seem many when compared with the installations for the last year, during which one hundred and fifty-four local lighting companies were organized ; one hundred and twenty, or ten a month, being plants supplying both the arc and incandescent light.

Sir John Pender.

Recently John Pender received from Queen Victoria the honor of knighthood. The honor though long delayed comes at last to crown a man whose name has been linked with the inception and progress of sub-marine telegraphy. Sir John Pender was chairman of the British & Irish Magnetic company when the Dover cable of Mr. Brett and the abortive attempts of Frederick Newton Gisborne to connect Newfoundland with England were made. When the immense Atlantic project was broached he was one of the 345 men who contributed £1,000 each to let the experiment be tried. His name appears from that time in the list of directors for seven or eight years, during which time cable after cable failed, and a more far-seeing or sanguine man than Sir John Pender would have given up the project in disgust. The first two cables, when everything looked bright, sunk within a few hundred miles of the Irish shore, and the system was not then far enough advanced to recover them by grappling. Matters looked very gloomy at that time. The Atlantic company's appeal to the public for subscriptions had fallen flat, but Sir John organized the Anglo-American Cable company, with a capital of £600,000, and went forward bravely with the work. The first interest of the new company was to provide for the laying of a perfect cable, to which end experiments, both scientifically and experimentally, had been made through former failures. Mr. Pender negotiated with the Gutta Percha company for the necessary covering for the cable, but at the critical moment the Gutta Percha company announced that they would lose all their regular business if they devoted their works exclusively to making a covering for the cable. As they were about to back out Mr. Pender inquired : "How much guarantee do you want?" "A quarter of a million sterling," was the reply. "Will you take my personal guarantee for it?" "Yes." "Then you have it," said Mr. Pender. The cable was not only successful, but the same expedition that lost it found the former cable that had been lost. This result would have been enough to crown the adventures of an ordinary man, but Sir John had no sooner seen the Atlantic cables established than he proceeded to work indefatigably in the organization and development of the Mediterranean, the Eastern (East India and China), Australian, South African and Direct African Cables ; in short, a system covering the entire world, and of which the American cables are but a minor part.

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 25. — Attention has been called in these columns to the numerous complaints about the electric lights on the Brooklyn bridge and along the East and North river fronts, as dangerous to navigation. Pilots claim that the glare of the lights on the water blind their eyes so that they can not distinguish objects between the lights and their boats. The American Brotherhood of Steamboat River Pilots took the matter to the board of aldermen and at the last meeting of the aldermanic committees on ferries and franchises it was decided that the gas commissioners be instructed to request the electric light companies to shade all their lights on the river fronts.

Commodore Gerry's bill, providing for the execution of criminals by electricity instead of by hanging, seems to be making progress in Albany, for it was reported upon favorably in the assembly.

A coroner's jury, after a thorough examination of the case of Leonard Jones, the employe of the Western Electric company, who lost his life in the Sixth avenue subway January 21st, has found that his death was accidental. The subway company is exonerated from all blame in the matter.

The bucket shops on lower Broadway are still doing business, but to a very limited extent The stock exchange people have up-hill work in trying to keep quotations from them. They are defiant and claim that the opposition to them will be short-lived and that there is not money enough in the stock exchange to shut them up.

Electric light wires are blamed for a fire which occurred recently in the banking offices of Vermilye & Co., in the Fourth National bank building on Nassau street, and did damage to the extent of about $3,000.

F. E. Kinsman, general manager of the Electric Construction and Supply company, states that the demand for Simplex lamps has never been so large as at present. The Simplex lamp is designed especially for use on incandescent circuits, and it is also used to some extent in connection with storage batteries.

The *Times* states that the West Indies Cable company's steamer Grappler has just successfully finished repairing the telegraph cable broken between Jamaica and Colon, a work upon which she has been engaged since last November; that about sixty miles of new cable were laid, and that the original cable, laid seventeen years ago, was picked up and found to be in an almost perfect condition.

The New York Insulated Wire company, J. W. Godfrey, general manager, are meeting with great success in the sale of the Grimshaw insulated wires. The new post-office building at Philadelphia is wired throughout with Grimshaw wires and the Edison Electric Light company, of Philadelphia, are using it almost exclusively in their work.

The report of the special assembly telephone investigating committee will, it is expected, be presented to the assembly next week. Rumor has it that the report will be simply a series of lamentations, without much definite advice. Nothing more could be hoped for, as the Bell company seem to be entirely protected by their patents and their contracts.

Wm. McMasters, a printer, who resides at 537 Wythe avenue, Brooklyn, dropped dead this week while treating himself with a medical battery for heart disease. A medical battery is usually regarded as harmless, but in this case the daily papers put it on a par with the deadly electric light wires. The report of the coroner's jury has not yet been published, but it is to be hoped that they have given the heart disease a due share in the cause of death.

The streets of New York are saturated with gases, and the opening of the subways, and the death of Leonard Jones recently in the Sixth avenue subway, have attracted attention to danger from this source. James Jacobs was found dead in his bed this week at 137 West Broadway, and Deputy Coroner O'Meagher found that death resulted from the inhalation of illuminating gas. This was remarkable, as no gas is used in the house, and there are no gas fixtures at all in the room where Jacobs died. The gas is supposed to have come from the street in great quantities through the sewer and waste pipes.

The Sawyer-Man Electric company are fitting up the Okonite company's factory at Passaic, N. J., with a 400 light incandescent plant. Among other large orders recently received by the Sawyer-Man company are the following: Hazeltine Building, Philadelphia, Pa., 1,000 lights; Phenix Manufacturing company, Paterson, N. J., 400 lights; Atlantic Brewery, Stapleton, S. I., 200 lights; Murray Hall hotel, Pable Beach, Fla., 400 lights; Wilder & Co., Olcott Falls, Vt., 250 lights. A.

Kansas City.

KANSAS CITY, Mo., Feb. 25.—At the invitation of C. S. Rusling, the genial representative of the Thomson-Houston Electric Light company in this city, your correspondent inspected the new Thomson-Houston plant installed in the Kansas City Cable Railway company's power house at the corner of West 9th and Washington streets. The dynamo of 25 2,000 candle power lights capacity, is located in the power room of the cable house and is run by a 25 horse power high speed engine of the New York Safety Steam Power company's make. Near by a very complete switch-board controls the several circuits This machine furnishes current for six arc lights and twenty-four 16 candle power incandescent lights introduced by means of the Thomson-Rice individual distributor at the power station; four arc and twenty-four 32 candle power incandescent lamps furnish light on the incline or viaduct; sixteen 16 candle power lights are tastefully arranged in the elevator station at the foot of the incline. The plant as installed is designed to run during the entire 24 hours of the day and for this reason the circuits are so arranged that the superintendent in charge can cut out any certain group of lights that is not in use from time to time. A small six-light dynamo is cut into the circuit during the daytime furnishing light for the engine and boiler-room, the large dynamo doing full duty during the night. The plant is perfect in every detail and is giving great satisfaction. This is the second installation the Thomson-Houston company have made for the cable railway company. Mr. Rusling states that his company are installing a large number of these combination arc and incandescent plants and that recent reports from those operating them show that they are getting a very long average life from all of the incandescent lamps in this way; in one case the average life of 100 lights was over 1,200 hours. The installation of the plant was made by the Western Electric Construction company of this city.

After much study and perseverance the Missouri and Kansas Telephone company have arranged and installed a system for fire alarms that in itself is perfection. The credit of this system is due to Mr. Smith, the company's superintendent, and Mr. Barrett, the electrician. To understand this system intelligently one must know that the engine houses—nine in number—are on a metallic circuit connected with the exchange. When a subscriber turns in an alarm of fire, the operator at once connects him with the chief operator who after finding the location of the fire, turns in one long ring on the fire alarm circuit which rings at each and every engine house in the city, and meaning, "*hitch up.*" A man at once steps to the telephone in each house and before the engines are ready to start he has received the exact location of the fire. At the same time that the chief operator is connected with the subscriber a large gong rings telling all operators that there is a fire. Word is then passed to the 38 operators giving the location of the fire. As stated, the engine houses are all connected on a metallic circuit arranged in a circle. Across this circle a wire is run connecting the center house so that if a break occurs, by means of a three-point switch another circuit can be formed with half of the department. An alarm is rung in and a "hitch up" ordered three times each day in order to test the working of the system. Statistics will show that our city's losses from fires have been very small—thanks to a perfect alarm system, a good chief and hard working firemen.

The United States Electric Lighting company have just finished the installation of three of their dynamos in Jacob Dolds & Sons' packing house, two incandescent and one arc. The incandescent machines have a capacity of 400 lights each and the arc a capacity of ten lights. Seven hundred lights of 16 candle power each and 8 arc lights are now in use. The power is furnished by a Hamilton-Corliss engine 16″ x 42″ of 80 horse power. The installation was made by Mr. Fredricks of the United States company. Kerite wire is used throughout.

The American Electric Light company of this city are to use P & B wire for their circuits through the city. They expect to have their lights running within a few weeks. The line is to be constructed under the supervision of O. W. Ditsch, the manager of the company.

George Hewes, who has for six years acted in the capacity of superintendent for the Home Telegraph & Signal company, has severed connections to accept a position as general superintendent of the Mooney & Boland police patrol lately organized in our city. The firm will find Mr. Hewes a very valuable man.

W. A. Hammett, manager of the New York Safety Steam Power Co., was in our city last week, and while here placed a 100 horse power engine in the American Electric Light company's new engine house, Southwest boulevard.

O. W. Ditsch, superintendent of The American Electric Light company, left last night for a business trip to Chicago and the east.

The Inter-State Electric Co. have just received an antique oak 60-number Hess return call annunciator. It will be placed in the Hotel Martin in this city. D.

From Salina, Kan.

SALINA, Kan., Feb. 25.—The occasion of the starting of the Fort Wayne Jenney Electric Light company's new plant at this place, February 11th, was made one of celebration. Handsome cards of invitation were sent out by the Salina Electric Light & Power company through President J. F. Burrows and Secretary William R. Geis. The cover of the invitation was embellished with an engraving of a charming maiden, bearing in one hand a candle, while the other hand reflects the light upon her face. The original of the engraving is familiar, and is a favorite in art circles for its unique conception and fine execution. The engraving on the card of invitation is appropriately labeled "One 'Jenney' candle power." The equipment of the plant is given in detail as follows: Electrical: Two automatic incandescent dynamos, 500 lamp capacity each; two rheostats; one ammeter; two voltmeters, and a variety of smaller appliances; twenty-two miles of wire in mains, 35,000 feet of wire in buildings and connections with mains; 135 subscribers, 74 residences, and 61 commercial. Steam: One Buckeye automatic cut-off engine, 110 horse power; two steel tubular boilers, 100 horse power each; one Hooker patent plunger boiler feed pump; one automatic injector; one 200 horse power feed water heater and purifier; one steam force pump, for forcing water into elevated tanks.

The officers and directors are as follows: J. F. Burrows, president; Geo. Krueger, vice-president; W. R. Geis, secretary; W. F. Gilbert, treasurer. Directors, John Buchi, W. F. Gilbert, J. F. Burrows, George Krueger, Wm. R. Geis, Joseph Seubert, Henry Lehman. C.

Notes From Kansas Towns.

STERLING, Kan., Feb. 25.—In this place and at Nickerson, Kan., the incandescent plants of the Fort Wayne Jenney system are running to their full capacity and giving satisfaction.

In Lyons, Kan., the local company are so well pleased with their Fort Wayne Jenney plant that they accepted it two weeks before the time specified in the contract. They also ordered a 200 light incandescent outfit, which is being put up now.

At Burrton, Kan., the smallest city in the United States, indulging in electric lights, F. Stocker, of the Interstate company, is busy enlarging the storage battery. An 80 ampere Fort Wayne Jenney machine is used for charging the accumulators. Mr. Stocker is quite enthusiastic about the performance of the dynamos. P.

Indianapolis Items.

INDIANAPOLIS, Feb. 25.—The people of Rockville, Ind., have been agitating the subject of electric lighting for streets and business houses. An agent of the Edison company reports having secured over 200 subscribers and that the indications are that many more will subscribe.

The Indianapolis District Telegraph company are canvassing the city with the intention of establishing a merchants' private patrol, provided enough subscribers can be secured. The plan is to put a number of patrol boxes, in each square, connected with their main office, to which the private watchman can send signals as often as agreed upon between subscribers and the company. Each box will have four signals, one the watchman's report, one for police, one for fire and one calling for company's wagon. The success in procuring subscribers so far, is quite encouraging.

The subject of an electrical railroad between this city and Broad Ripple, a pleasure resort, ten miles north of the city, is again being canvassed and is backed by men of means. The route

takes in Crown Hill cemetery and Mapleton, a suburb four miles north, and with proper management should be made a success, as at present there is no means of transportation out of the city in any direction.

The city's contract with the Artificial Gas company for street lighting expires March 1st; with the present unlimited supply of natural gas for fuel there is no good reason why electricity should not be used and at a reasonable rate. The city is paying $75,000 per annum at present. This certainly ought to be a good field for an incandescent company to furnish inside lights for business houses and dwellings. At present the only light of the kind in use is at the hotels most of which have private plants.

The tower of the telephone exchange at Greensburg, Ind., caught fire from lightning Friday night during a thunder storm, but was extinguished before much damage was done.

The Bidwell Electric company of Chicago will build an electric street railway in Valparaiso, Ind. The line will be about one and one-fourth miles long and run on Main and Franklin streets and Calumet and College avenues. The fare will be five cents. The speed is not to exceed eight miles an hour. The charter is for fifteen years. Work must commence within ninety days and the road be in operation before a year. The city will exempt the road from taxation for five years. M.

From Erie, Pa.

ERIE, PA., Feb. 25.—The Postal Telegraph company contemplate running their wires into this city from Cleveland. It is said that the contract for the construction has already been let.

Geo. W. Baxter, late manager of the B. & O. Telegraph company at Erie, has received an important appointment with the telephone company at Cleveland, Ohio. F.

THE ELECTRIC LIGHT.

The Minnesota Brush Electric company is now burning about 800 arc lights.

The city council of Holton, Kan., has granted to W. P. Todd, C. W. Durfee, L. H. Smyth, of Holton, and William Bowen, of Oskaloosa, a franchise for electric lights. The plant will be in operation within three months.

The Hyde Park, Ill., trustees have granted to the Citizens' Electric Light and Power company, of Kensington, a franchise to string wires in the town.

The West Side Incandescent Electric Light company of Chicago, has been incorporated with a capital stock of $50,000. The incorporators are E. Tuttle, F. A. Wunder and L. G. Bronson.

The Northwestern Electrical Accumulator company, of Chicago, has closed a contract for an installation of incandescent lights at the Thomson & Taylor Spice works. The current is to be supplied by accumulators.

The Emporia Electric and Gaslight company has recently installed a Brush Electric light plant at Emporia City, Kan.

Nathan S. Keith, of San Francisco, Cal., has commenced an action in the United States Circuit Court against the Pacific Coast Electrical Construction company. and the Oakland Electric Light and Motor company, to restrain the defendant corporations from manufacturing and using a certain form of dynamo of which he claims to be the inventor.

The Fort Wayne Jenney company has made an installation of 1,200 incandescent lights at Salina, Kan. The *Republican* of that city asserts confidently that Salina is the best lighted city of the west.

Bellevue, O., is considering the question of putting in an electric light plant.

The Gatti Bros., of London have demonstrated their faith in electric light by expending $75,000 for a plant to light the Adelaide Gallery, the Adelphi and two other buildings in that vicinity.

A new electric "night light" has been invented in England which with its push-button is fitted to the wall at a convenient distance from the bed. The lamp is a single candle power of four volts.

The Fort Scott, Kan., Electric Light and Power company has been organized with $100,000 capital. The incorporators are: W. H. Stout, C. F. Drake, A. W. Walburn, R. J. Harris, of Fort Scott; T. P. Bailey, of Chicago, Ill.; Wm. D. McQuestenn, C. S. Rusling, of Kansas City, Mo.

In the United States circuit court in Chicago Monday last a jury rendered a verdict of $20,000 against Cook county in favor of the United States Electric Lighting company as a payment due upon a contract for an electric light plant.

The Tonawanda, N. Y., Electric Light company has been organized.

C. A. Coffingwell has been awarded the contract for lighting Shreveport, La., with electric light for the next three years.

The Glasgow board of trade is about to make the experiment of connecting lightships on the Goodwin Sands with the shore by means of an electric cable. Should this means of illumination prove successful the system will be extended.

Hibbard, Spencer & Bartlett, hardware dealers at the corner of Lake street and Wabash avenue, Chicago, are having an isolated Edison plant installed, and will entirely dispense with the use of gas. To provide against the necessity of running the engine and dynamo during the night in case it is necessary to have the offices lighted, the company has ordered a set of fifty-five cells of storage battery of the Northwestern Accumulator company. These cells will be charged during the day time and can be drawn upon whenever necessary.

THE ELECTRIC MOTOR.

Manager S. S. Leonard, of the Minnesota Brush Electric company, at Minneapolis, Minn., has found a novel use for the electric motor. The managers of a toboggan slide which was lighted by electricity appealed to him for some method of drawing the toboggans to the top of the slide. Steam power was out of the question on account of the severe cold and accordingly he placed a two horse power Brush motor at the top of the slide and connected to it an endless cable provided with slats. Now the merrymakers after enjoy the rush down the slide, draw their toboggans to the proper place and the travelling cable draws the toboggans up the slide while the tobogganers walk up the stairs. The one drawback to the sport, the labor of carrying the toboggans up the stairs has been removed, and those partaking in the sport doubly enjoy it.

The Akron Street Railway company will extend their road in the near future and use electricity as the motive power.

The announcement is made that an electric railroad has been projected from Buffalo, N. Y., to Tonawanda and Gratwick. The Elmwood avenue electric railway is to run from the foot of Washington street to the park, and thence out the Military road to Tonawanda, one of the objects being to make the park a pleasure ground for Tonawanda people.

The Chicago & Cook county Passenger Railway company, 238 Randolph street, Chicago, propose to build and equip elevated railways on the Hannahs system in Chicago with electric motors and the electric light. Its officers are Louis Wahl, president; J. M. Hannahs, vice-president; and C. Wahl, C. B. Farwell, P. E. Studebaker, W. W. Kimball, W. P. Rend and Cyrus Bentley, directors. More than half the right of way has been secured on some of the principal streets, and the canvass is being pushed vigorously.

THE TELEPHONE.

The telephone is an important factor in the transaction of public business in the department buildings at Washington, although the number of instruments is not as large as a year ago. The department telephone is arranged on a swinging support so the official need not rise when he wishes to use it. The cabinet officers find the telephone so useful that they have it in their residences and by its use they are enabled to linger for a longer time over their late breakfasts. The legislations are provided with telephones, and it is reported that when the heaviest wire is employed, Russians, Chinese and Corpeans may talk without breaking the circuit.

The complaint has been made in Chicago that the Chicago Telephone company, contrary to the ordinances, was stringing wires. Prof. Barrett has made an explanation that the city was stringing wires for the several departments, although the corporation would not allow the company to follow suit.

The administrative council of the Brussels exhibition has determined to make an especial feature of telephonic apparatus, and the participation of all companies is invited. It is expected that all the latest improvements, especially those in switchboards, will be represented. A large number of call stations will be erected.

The telephone and the electric light are in successful operation in Finland. The telephone is employed not only in the towns but in the country.

A new microphone transmitter has been patented by Messrs. Siemens & Halske, of Vienna, in which the loose contacts consist of hollow carbon cones placed within each other. The object of this arrangement is to facilitate a change of the surfaces in contact, and prevent deterioration under the influence of the current.

THE TELEGRAPH.

Superintendent Tuttle of the North American Telegraph company, is reported as saying that the corporation would begin in the spring the building of a line from Duluth to Winnepeg.

The telegraph committees of the Iowa legislature, have under consideration several bills for the regulation of message rates. One measure provides that the maximum charge for a ten-word dispatch between two points in the state shall be 25 cents, and one cent for each additional word. When the message passes over more than one line a half rate additional may be charged. A second bill provides that within the state of Iowa the maximum rate shall be 25 cents for twenty-five words, and one cent for each additional word. The third bill fixes the rate at 20 cents for fifteen words and half a cent for each additional word. The senate committee has received a notice from the Postal Telegraph company stating that the corporation had intended to extend its lines into Iowa the coming season, but it could not do so if either of these measures was adopted.

The Louisiana supreme court has handed down a decision affirming a decision in favor of the defendant of a lower court in an action brought by Jean Deslattes and others against the Baltimore & Ohio Telegraph company. The action was brought to secure $2,500 damages alleged to have been sustained by the failure of the company to deliver a message. The court held that the message was not properly addressed and that the company used ordinary diligence to find the addressee.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	350	360
Central Union	46	47
Michigan	76	77
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	68	69

Personal Paragraphs.

George M. Callender, of the Callender Insulating and Waterproofing company, of New York, was a recent visitor to Chicago.

Among the messenger boys in the service of the first telegraph office opened in Pittsburgh, Pa., years ago, were four known respectively as Andy, Bob, Billy and Harry. This quartette has won both fame and fortune. "Andy" Carnegie is one of the richest men in the United States, "Bob" Pitcairn is general agent and superintendent of the western division of the Pennsylvania Railroad, "Billy" Moreland is city attorney of Pittsburgh, and "Harry" Oliver has made a fortune in steel and narrowly missed a seat in the United States Senate.

D. H. Louderbach, well known in the electrical business as vice-president of the Central Union and Michigan Telephone companies, has accepted the general management of the Chicago

Edison company. The directors of this company are to be congratulated in securing a gentleman of Mr. Louderbach's ability. His commercial knowledge and his long connection with telephone and electric light interests well qualify him for the management of business of such magnitude. His familiarity with corporation affairs makes this appointment all the more gratifying to directors of the company. The business of this company not alone embraces the present plant in the center of the city, but also the entire isolated business of Cook county, where at the present time they have about 40,000 Edison lamps already installed. The fine building now being erected by the company as its central station, under Mr. Louderbach's management, will no doubt be completed in the near future.

Miscellaneous Notes.

The Magnesia Insulating company, at Chicago, Ill., has been organized by Alfred C. Kemper, Horace Croft and H. F. Grier. The capital stock is $25,000.

Several members of the New York stock exchange have organized the Electro-Pneumatic Transit company, for the transmission of messages, reports and even stock through pneumatic tubes. This plan has been adopted as a result of the constant betrayal of secrets by messengers.

New York florists perform an interesting experiment of writing names on the leaves of flowers by means of a fine electric needle. The needle traces lightly the name, killing the parts which it touches and driving the color out. The effect is shown best on a red or yellow leaf.

The Northern Ohio Electric Service company of Toledo, O., has been incorporated. Capital stock $100,000.

George Fay, an eccentric Englishman, will have a telephone and electric light in every room of the nine-story palace which he is building at Guanajuato, Mexico.

Before the Glasgow Philosophical Society William Bottomley recently read a paper on the heeling error of ships' compasses. He assumed in treating the subject that when the ship was on an even keel the effect of the magnetism of the ship's iron was compensated by the plan of placing magnets fore and aft and thwartship to correct the semi-circular error and masses of soft iron on each side of the compass for correcting the quadrantal error. When the ship heeled over there was an altered condition and the heeling error was caused. Mr. Bottomley advised a plan by which the masses of soft iron on each side of the compass should be attached to the binnacle and thus move with the ship.

In the March number of *Scribner's Magazine* is an article upon the electric motor and its applications by F. L. Pope. As might have been expected the article is ably written and is interesting to both technical and non-technical readers.

"Recent developments of electricity as an industrial art" is the title of a well written and well illustrated article in a supplement to *Harper's Weekly* of February 25th by Schuyler S. Wheeler, electrician and superintendent of the C. & C. Electric Motor company of New York. The range of the article is very wide, nevertheless each department is handled in a satisfactory manner and the popular style in which it is written adds to its educational value.

Business Mention.

The North-western Electrical Accumulator company has succeeded Johnson, Holland & Co. C. N. Fay is president and James W. Johnson, treasurer and manager. The office of the company is at 222, 223 and 225 Phœnix building, Chicago.

The Callender Insulating and Waterproofing company of New York have just issued a very neat price list of their insulated wires and cables. The printer, John Bingham, is up with the times for he uses the electric motor to run his presses.

Chas. A. Schieren & Co., of New York, report sales of leather link belting to the following electric light concerns for use on dynamos: West Chester Electric Light company, West Chester, Pa.; Narragansett Electric Light company, Providence, R. I.; Richmond Light, Heat & Power company, Staten Island, N. Y.; Thomson-Houston Electric company, Seneca Falls, N. Y.; Fort Wayne Jenney Electric company, Fort Wayne, Ind.

James Rees, of Pittsburgh, Pa., has lately remodeled his large works and is now building the Pittsburgh automatic engine. His works are said to be the largest in the country manufacturing single-valve automatic engines.

The Kookogey Electric company, of 40 Dey street, New York, are furnishing a primary battery for very small electric light installations.

J. M. Bachert, manager of the Reliance Oil and Grease company, states that their trade with the electric light people is exceedingly good at present. This company has made the wants of their consumers a study for years, and have brought into the market a class of goods which are beyond the average competition.

In *The Industries of Cleveland* published recently is found a description of the immense plant of the National Carbon company of that city. The data for the article in question were secured late last fall but the largely increased demand for arc light carbons during the winter has forced the company to add to their capacity, in order to keep pace with the demand. At present the capacity of these works reaches the grand total of 2,500,000 carbons per month, and affords a striking illustration of the immensity of the arc lighting industry of the country, as well as the rapid growth of one of the best known and most successful carbon companies.

The Taylor Manufacturing company of Chambersburg, Pa., has just issued a neat catalogue illustrating and describing the Beck engine. The catalogue is full of information and, besides containing data referring more especially to details, it gives plans for setting up engines.

Electrical Patents.

Issued Feb. 14, and Feb. 21, 1888.

377,742. Lightning Rod Attachment for Windmills. Eugene O. Daniels, Springfield, Ohio.

377,745. Galvanic Battery. Theodore M. Foote, Boston, Mass.

377,763. Printing Telegraph. Jacob H. Linville, Philadelphia, Pa.

The invention is illustrated by twelve sheets of drawings. The description covers fifteen pages and the claims one hundred and fourteen in number cover sixteen pages more. We give claim 25: "In a printing telegraph system, an instrument organized as a transmitter at a subscriber station, a printing line circuit and a type wheel line circuit, keys and sunflower segments in said printing line circuit, an escapement electro magnet in said type wheel line circuit and both circuits connected to ground at the transmitting and central stations, printing and type wheel line batteries at said central station with the electrodes thereof normally connected to ground, a shaft driven by suitable force at said central station, a pulsator, a ratchet wheel and a type wheel frictionally connected with said shaft, an electro-magnet in said printing line circuit, its armature, detent lever, and retracting spring controlling said ratchet wheel and pulsator, instruments organized, substantially as described, as receivers at subscriber stations, with the printing and type wheel lines grounded around the sunflower segments and key-board, and means for connecting the type wheel and printing lines of a subscriber receiver and the type wheel and printing lines of a subscriber transmitter with the batteries at said central station through said pulsator and printing and detent electro-magnets at the central station, whereby the type wheels of the transmitter and receiver connected in line are rotated in response to pulsations by the said central station pulsator, and said detent electro-magnet at the central station and said printing electro-magnets at the subscriber station in circuit are controlled by the character keys of the subscriber instrument organized as a transmitter."

377,788. Telephone system. Edward P. Trayer and Geo. H. Kugler, New York, N. Y.

377,851. Electric Fuse. Perry G. Gardner, North Adams, Mass.

377,862. Combined Telegraph Key and Sounder. Bartholomew Oehmen. New York, N. Y.

377,872. Electro Medical Apparatus. Theodore R. Ten Broeck, New York, N. Y.

377,879. Telegraphy. Clement Ader, Paris, France.

This method of receiving is designed to render the signal audible.

377,884. Current Regulator for Dynamo Electric Machines. Walter A. Crowdus and Henry M. Sutton, Dallas, Tex.

377,894 Support for Electric Conductors. Maurice J. Hart, New Orleans, La.

377,895. Secondary Electric Clock. Wirt B. Harvey, Memphis, Tenn.

377,916. Electric Bell. Jacob P. Tirrell, Somerville, Mass.

377,953. Tubular Metallic Pole for Telegraphic and other uses. Anson Mills, U. S. Army.

377,994. System of Electrical Conversion. Edward N. Dickerson, jr., New York, N. Y.

The invention relates to a system by which a non-reversing high tension electric current may be converted into a low tension reversing current at the point where it is desired to employ it.

377,996. Dynamo Electric Machine. Rudolf Eickemeyer, Yonkers, N. Y.

377,997. Frame for Winding Armature Coils. Rudolf Eickemeyer, Yonkers, N. Y.

378,021. Underground Electrical Conduit, Robert F. Silliman, Troy, N. Y.

378,029. Electric Current Indicator. Ernest P. Warner, Chicago, Ill.

The device is an ammeter, designed to be used by those little skilled for measuring the strength of electric light currents.

378,030. Telephone Exchange Central Office Connection. Ernest P. Warner, Chicago, Ill.

The invention relates to multiple systems and is designed to avoid including the test battery in circuit except at the moment of testing. We give the claims: "1. The combination with a pair of cords and plugs, of a loop switch and a test battery in circuit between two contact points of the switch, and contact springs normally resting on said contact points to close the battery to the cords, and a telephone in a circuit branched from one of the contact points to ground, substantially as described. The combination, with a pair of cords and plugs, of a telephone included in a branch circuit to ground, a loop switch, with a battery in circuit between two contacts of the switch, and circuit changing devices for disconnecting the telephone and battery from the cords and connecting the two cords together, substantially as described."

378,044. Telephone Transmitter. Thomas A. Edison, Menlo Park, N. J.

The object of the invention is to produce a simple and efficient multiple instrument and an arrangement for working multiple instruments in circuit which will be more effective than those heretofore proposed.

378,078. Conductor for Electrical Fire Alarm Systems. William A. Barnes, Bridgeport, Conn.

The conductor is made up of sections of metallic compound fusible at say 500° Fahrenheit, the points being formed by soldering with an alloy fusible at a still lower temperature say 199° F.

378,107. Printing Telegraph. Daniel E. Pike, New York, N. Y.

378,115. System of Electrical Distribution by Secondary Batteries. John S. Sellon, Hatton Gardens, County of Middlesex, England.

378,121. Galvanic Battery. Hugo Walter, Cincinnati, Ohio.

Claim 1. "A battery for open circuit work, consisting of a permanently hermetically sealed or closed cell containing a negative electrode composed of crushed or granular carbon packed around and in contact with the solid carbon by which the current is led out, and a positive electrode composed of zinc having a protective wrapping of absorbent material, substantially as specified."

378,122. Galvanic Battery. Hugo Walter and William E. H. Marsh, Cincinnati, Ohio.

378,124. Electro-Magnetic Bell. Joseph Wetzler and Sigmund Wetzler, Hoboken, N. J.

378,137. Automatic Temperature Regulator. Warren S. Johnson, Milwaukee, Wis.

The temperature in each apartment is independently controlled and the action of the furnace checked only when the temperature in all the apartments has reached the required limit.

378,175. Telegraph Cable. William R. Patterson, Chicago, Ill.

The invention is designed to lower the electro-static capacity, the core consisting of conductors insulated with fibrous material. This core is dried, then alternate sections only are saturated with paraffine after which the lead pipe is formed over the core. We give the first claim: "The method of manufacturing electric cables, which consists in providing a dry core of conductors insulated by fibrous material, saturating said core in alternate sections with melted insulation."

378,181. Multiple Telegraphy. Charles Selden, Baltimore, Md.

Claim 3. "The combination, with a telegraph line, a part of which, at a way station, is composed of branch or multiple arc circuits, of graduators in said branch circuits, and a shunt, including a condenser, around the graduators in one of the arc circuits, substantially as described."

378,202. Electric Time, Temperature, and Burglar Alarm and Call Bell. Hans P. F. Jensen, Browne W. Webb and Jens Jensen, London, County of Middlesex, England.

378,250. Telephone Switch. Joseph R. H. Hinton, Baltimore, Md.

378,258. Manufacture of Incandescent Electric Lights. Theodore Mace, New York, N. Y.

Claim 1. "The process of preparing thread for the manufacture of incandescents, consisting in saturating a carbonizable thread with an oxygen-bearing compound of aluminum capable of being decomposed by the application of heat and yielding thereby alumina, and then applying heat and by it al ne decomposing said compound and leaving alumina, substantially as described."

378,259. Electric Railway. Charles T. Mason, Sumter, S. C.

378,298. Telephonic Transmitter. Moses G. Farmer, Eliot, Me.

Of the three claims we give the first: "In a telephonic transmitter, the combination, with the main electrodes, of an independent conducting-point of relatively small mass electrically connected to one of the terminals of the transmitter and in permanent yielding

contact with the electrodes of the opposite terminals, as set forth."

378,320. Alternating Current Transformer. Rankin Kennedy, Glasgow, County of Lanark, Scotland.

We give the third claim: "A main transformer wound with primary and secondary conductors, and also with a third conductor for a continuous current, in combination with an alternating current generator supplying an alternating current to the primary and a continuous current generator supplying a continuous current to the third conductor, for the purpose set forth."

378,321. Transformation and Distribution of Electric Energy. Rankin Kennedy, Glasgow, County of Lanark, Scotland.

378,332. Telegraph Key and Instrument. William A. Melbourne, Swanwick, Ill

378,339. Display Stand for Non-Magnetic Watches. Alfred C. Smith, New York, N. Y.

378,358. Incandescent Electric Lamp Fixture. Harry M. Doubleday, Columbus, Ohio.

378,375. Core for Dynamo Electric Machines. Winceslas C. Rechniewski, Paris, France.

378,385. Telephone Receiver. Alonzo W. Brown, Evanston, Wyo.

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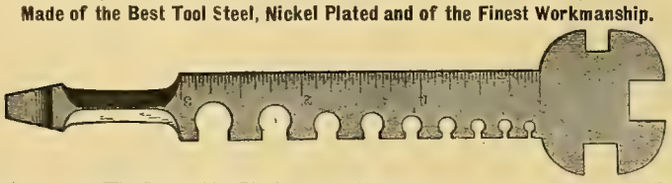
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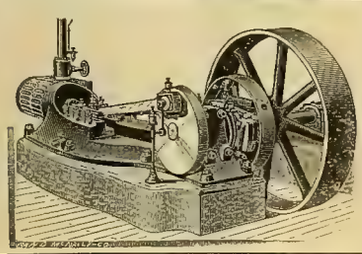

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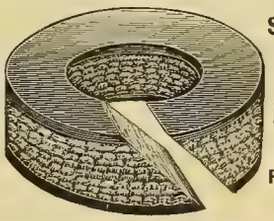

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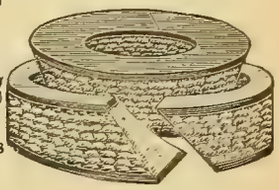

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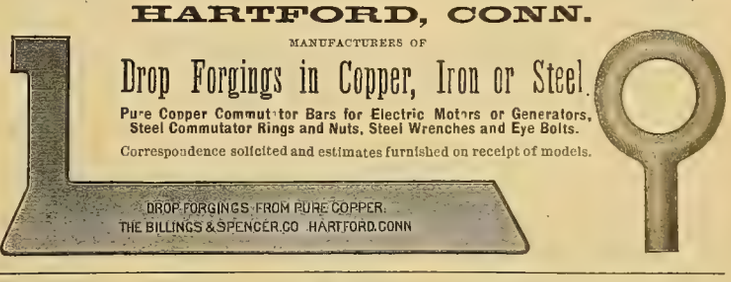

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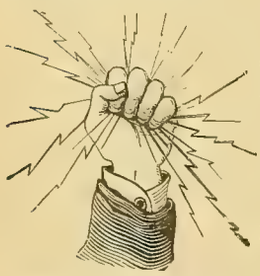

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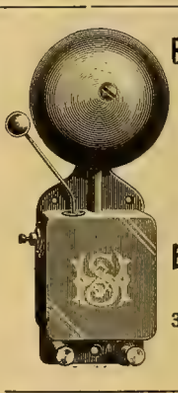

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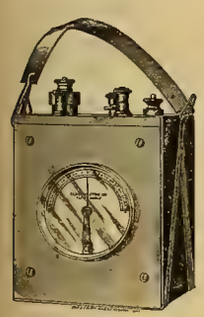

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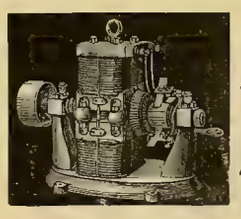

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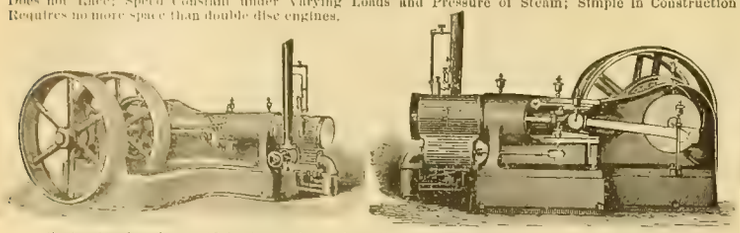

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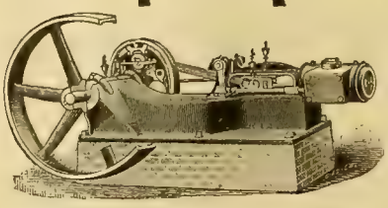

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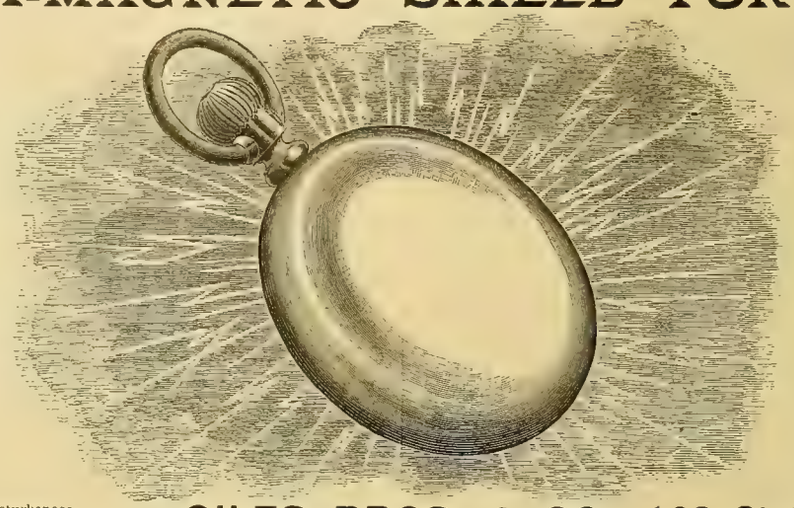

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The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

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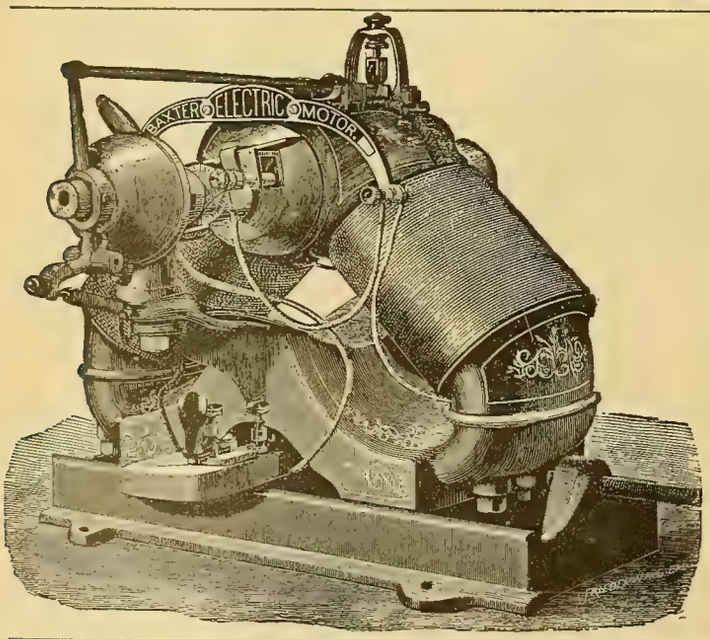

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THE ONLY PERFECTLY GOVERNED MOTOR EVER MADE.

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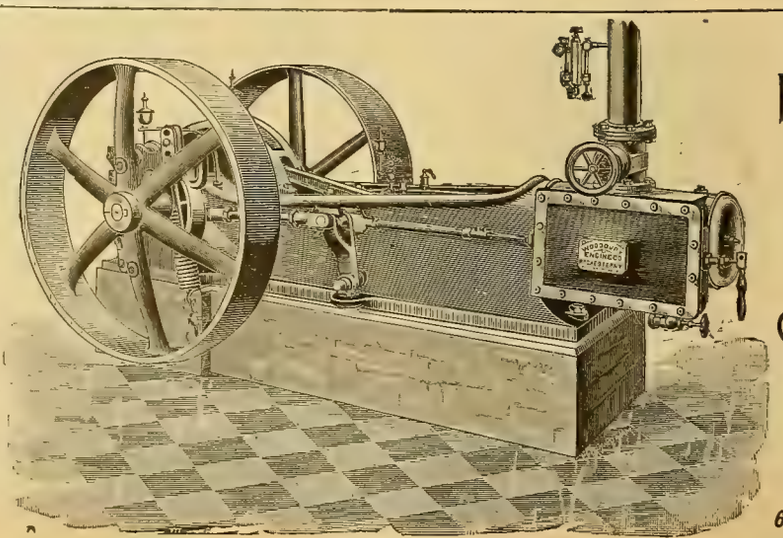

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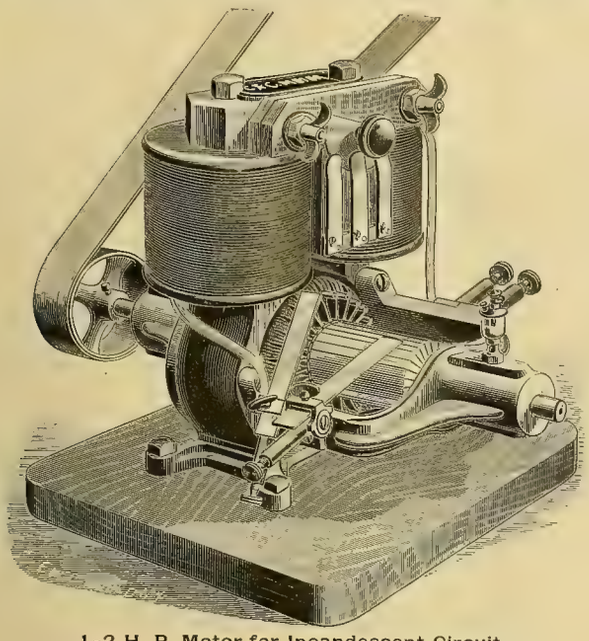

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MANUFACTURERS OF

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Lighting Apparatus.

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TRINIDAD LINE WIRE.

The attention of Electric Light, Telephone and District Messenger Companies is especially called to our new

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The universal condemnation of the so-called Underwriter's Wire, and the demand for something better, has induced us to offer our new TRINIDAD LINE WIRE as a substitute for its use, and at a very little higher price. This wire is served with two coatings of our Bitumenized Tape and braided over all. A serving of Trinidad Compound is put on between each tape and braid. The outside finish is neat, clean and strong. It will not liquify or become sticky with heat, nor brittle with cold. The covering is tough and tenacious, will stand rough usage and a rubbing contact without abrasion. We claim that our Trinidad Line Wire is the cheapest, well insulated and most serviceable wire offered for all Pole work, especially for high tension currents. This wire has received the highest indorsements, and is recommended as the best line wire by the Thomson-Houston Company, of Boston.

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ILLUMINATING COMPANIES proposing an extension of their Incandescent Plants are invited to correspond with the undersigned before commencing construction. With our recent improvements and reductions in price the cost of placing large Incandescent Cables underground in a solid and substantial manner is brought within actual business limits.

THE CALLENDER COMPANY have, during the last two years, laid many miles of large Cables underground, all of which are in actual work Almost every inch of the Underground Incandescent Work, both in this Country and in Europe, has been laid on the Callender plan The difference in cost between an overhead and underground system for Incandescent work is now no greater than is warranted by the better service insured by an underground system, The Callender Company's Underground Incandescent Cables and System have been in actual operation for some two years in twelve cities, and are indorsed by all the parent light companies.

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Weather-Proof Line Wire,

FOR ELECTRIC LIGHT PURPOSES.

The Insulation Resistance is good, and is not affected by moisture, heat, cold, acids or alkalies. But little more expense than Underwriters.

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EXPERIMENTAL WORK UNDERTAKEN, MODELS MADE, Etc., Etc.

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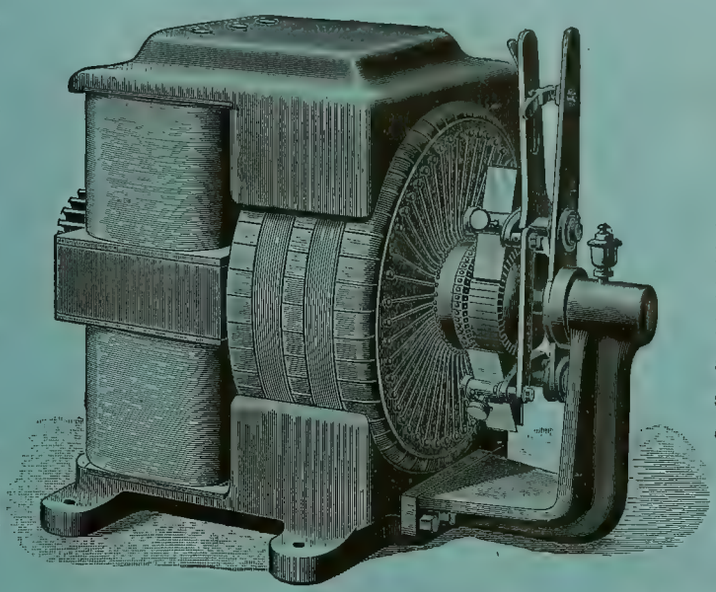
ELECTRIC RAILWAY APPARATUS,

Electric Arc Light Dynamos and Lamps,

CONSTANT SPEED STATIONARY ELECTRIC MOTORS, ETC.

Our Arc Electric Light unequalled. The only perfect Double Lamp. Thousands in use. Guaranteed equal to any in every respect.



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Electric Railways

ARE IN OPERATION AT

Appleton, Wis., Scranton, Pa., Montgomery, Ala., Detroit and Port Huron, Mich., Windsor, Ont., Binghamton, N. Y., and Lima, O., and are being constructed at Ansonia, Ct., Brooklyn, N. Y., and St. Catharines, Ont., Omaha, Neb., and Dayton, Ohio.

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Van Depoele Electric Lights Are in use everywhere and are daily growing in Popularity. Write for Illustrated Electric Light Catalogue.

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—OF—

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

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For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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SLATTERY INDUCTION SYSTEM

MANUFACTURED AND CONTROLLED BY THE

Fort Wayne Jenney Electric Light Company,

FORT WAYNE, INDIANA.

The most carefully worked out and complete Alternating System of Electric Lighting in Existence.

ARMATURE

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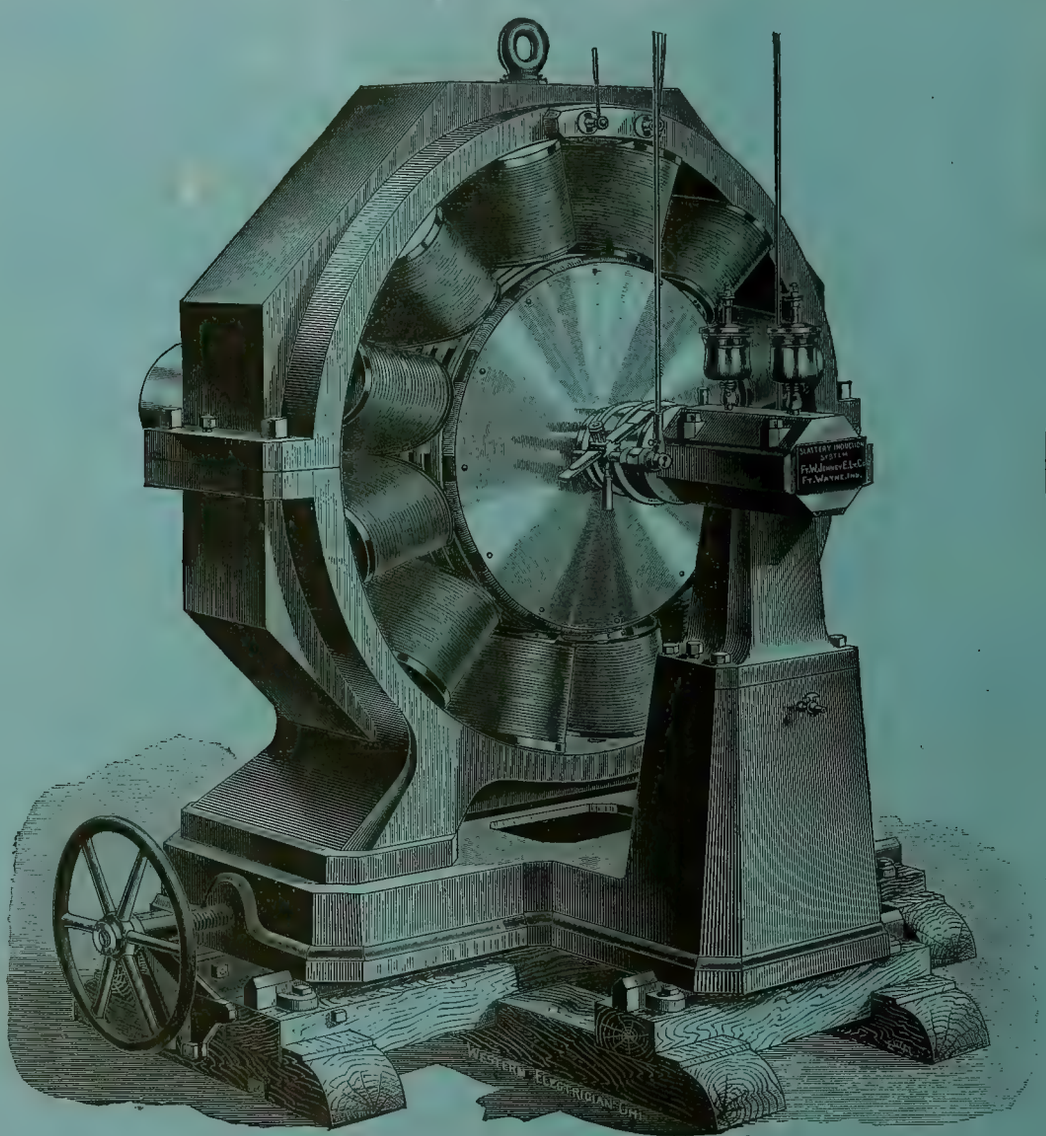

12

16

Candle Power Lamps

TO THE

Horse Power Guaranteed.

SLATTERY ALTERNATING DYNAMO.

Fort Wayne Jenney Electric Light Company,

MANUFACTURERS OF

The Slattery Induction System,

AND

THE JENNEY ARC DYNAMO AND LAMP.

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Western Electrician.

EVERY SATURDAY.

Vol. II. CHICAGO, MARCH 10, 1888. No. 10

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Standard Underground Cable Company,

General Offices, No. 708 PENN. AVE., PITTSBURGH, PA.

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

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All Sizes *Lead Encased Wires.*

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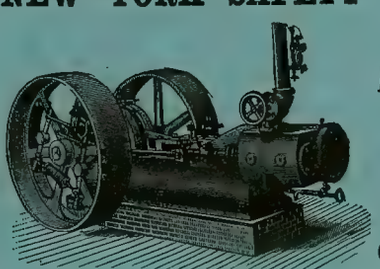

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Automatic Cut-Off Engines,

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And other duty requiring close regulation of speed.

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A NEW BELT

Especially adapted for use with Dynamos.

Write for particulars and prices to

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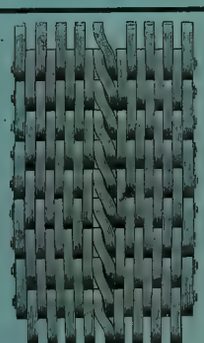

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Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

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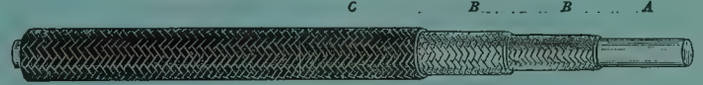

CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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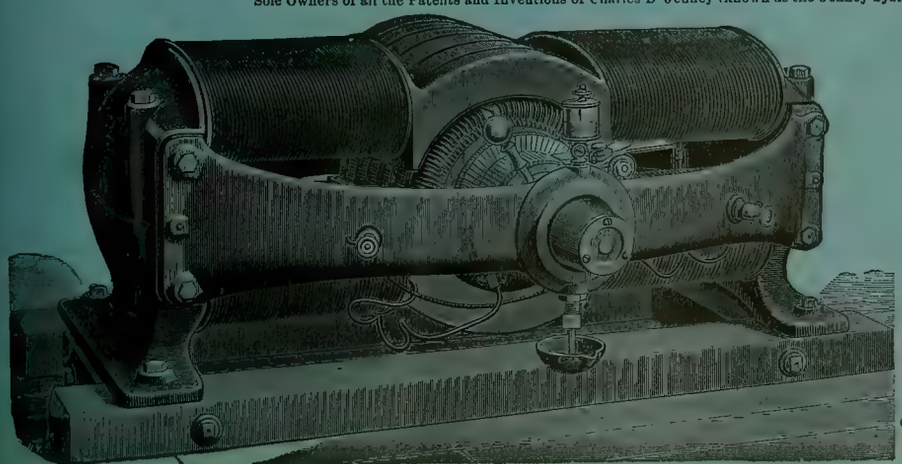
Sole Owners of all the Patents and Inventions of Charles D Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

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SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.

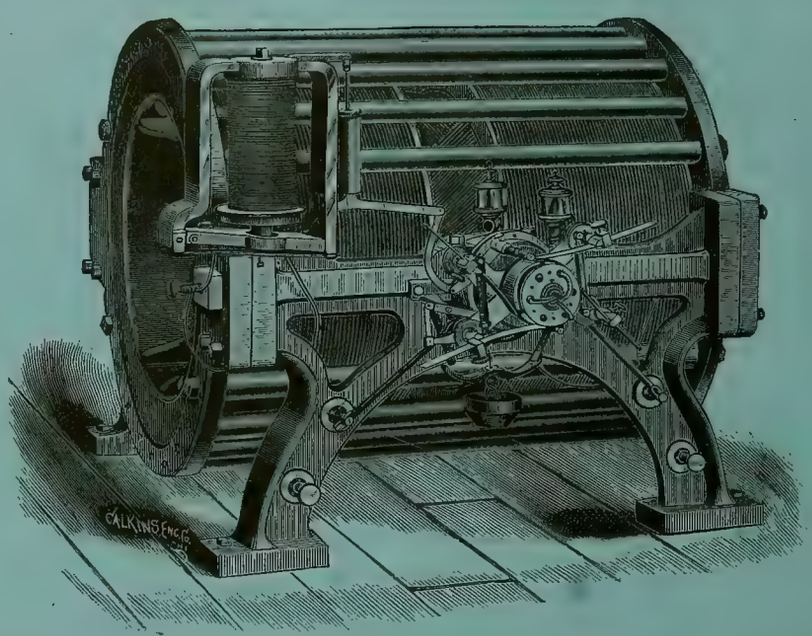
SERIES LAMPS

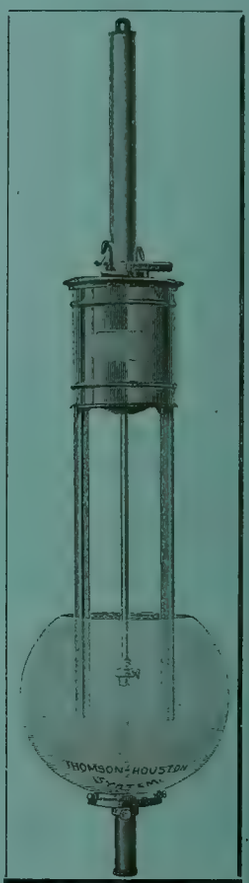
— FOR —

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



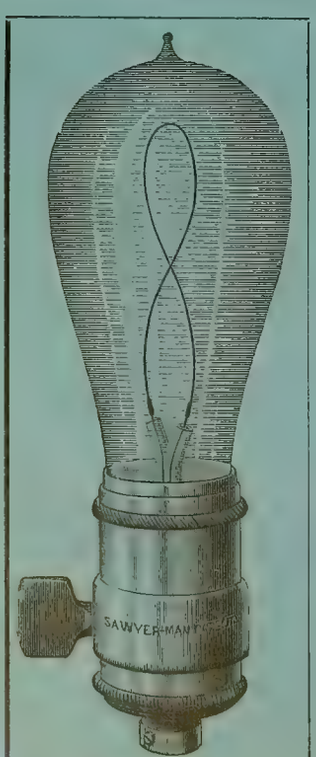


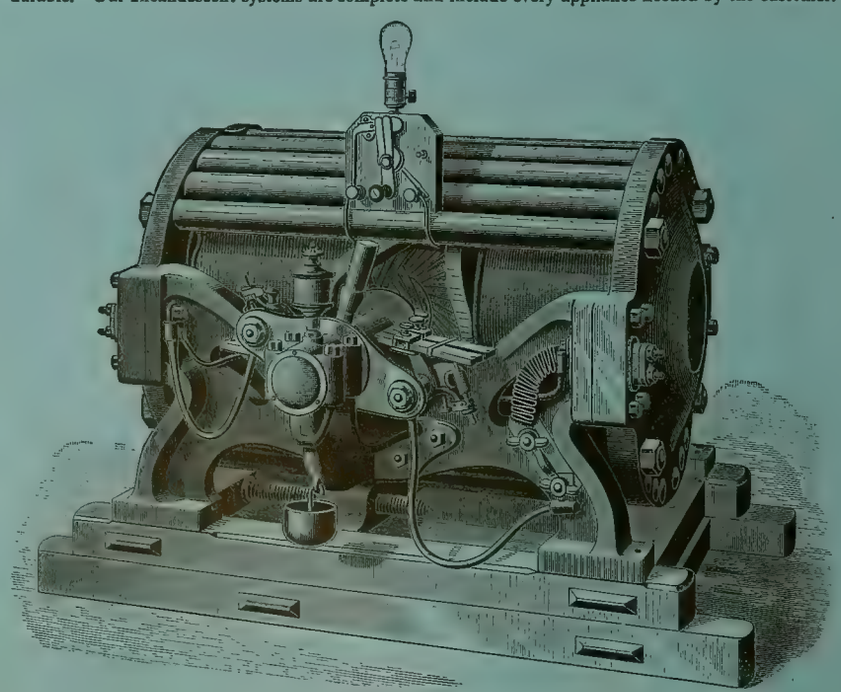
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS.

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

EDISON'S NEW LAMP.

Guaranteed Economy 12 16-Candle Power Lamps per Commercial Horse Power. Guaranteed average life, 600 hours.

EXTRACTS FROM RECENT LETTERS RELATIVE TO

PLANT IN PEOPLE'S THEATRE, MINNEAPOLIS

"I have read the statements of my electrician and engineer regarding the electric light plant put in my theatre some three months ago by you, and wish to say that I fully endorse all that they have said, and would say more if I thought it necessary. * * * The best indorsement I can give you is to say that if I were to purchase another plant, I should certainly select the Edison system. * * *

Yours truly, LAMBERT HAYS, Proprietor People's Theatre."

Letter from Edward H. Chase, Electrician, People's Theatre, Feb. 23, 1888.

"* * * In regard to life of the lamps, I can say that in my opinion they are lasting far better than I was led to expect. * * * We have 529 sixteen candle power lamps burning altogether in the plant, and we average five hours burning each day. We started up on the 31st day of October, and have run every day since. * * * This makes 120 days of running, and during that time we have only burned out 70 lamps, which I consider a wonderful record so far. I would like to state that I was led from the talk of agents of other companies to think that the lamps would become black after being run a short time. This is not the case. * * * We do not possess a single lamp that is at all black. I have tested the electromotive force on the lamps on the different circuits throughout the plant, and find there is not a variation of over half a volt. * * * It is certainly the finest equipped and working plant in this city, and one of which you should certainly feel proud. * * *"

Letter from Wm. D. Stevens, Engineer People's Theatre.

"The electric light plant in People's Theatre started Monday, October 31st, and has been running continually since that time. I have yet to find a flaw in its construction. * * * There has been absolutely no trouble whatever with the dynamos since they were started; and I wish to be emphatic in what I say, as I have heard that the opposition electric light companies assert that the plant is not working at all satisfactorily. I am running two incandescent light dynamos—Edison System—of 250 lights capacity each, with a high speed automatic engine of the Ide make. * * * The engine is developing with the entire load of 529 sixteen candle power lamps, about 45 horse power, which is doing better than represented. * * * The plant is visited by a large number of people, principally Engineers, and they all pronounce it to be one of the most beautiful running plants they ever saw. The working of the dynamos is simply perfect. There is no sparking of the brushes, and the commutators are at present as smooth as glass. * * * This is not the first experience I have had in running electric light, and think I am competent of judging whether the same is operating as it should. I am safe in saying that there is not a better or more satisfactory working plant in this section of the country. * * *"

Letter from F. C. Hughes, Electrician, Pillsbury Mills, Minneapolis.

"I have, at your request, made an examination of the electric light plant at the People's Theatre, and found it in good running order. * * * I visited the plant several times, both when running and when it was being wired, and I consider it the best lighted, and has the most complete regulating devices in the city, and great credit is due to the parties for the manner in which the plant is constructed."

Plants Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals 11 $\frac{50}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals 6 $\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS. FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager. **216 LA SALLE ST., CHICAGO.**

CENTRAL ELECTRIC COMPANY,

WESTERN AGENTS

OKONITE COMPANY

OKONITE TRADE MARK.

WIRES AND CABLES.

UNDERWRITERS' WIRE, MAGNET WIRE, INCANDESCENT CORDAGE, INSULATING TAPES,
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Pins and Brackets, Hard and Soft Rubber, Tubes, Sheet and Rod.

Fry's Patent Pliers and Connectors, Stubb's Pliers, Digging Bars, Shovels, Spoons, Wire Reels Fitted to Barrows or Wagon. Bits, Braces, Draw Knives, etc.

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BATTERIES, Law, Microphone, Crowfoot, Smee, Prism, LeClanche Disque, Bunsen, Grenet.

Bronze Pushes, Wood Pushes, Floor Keys, Annunciators, Burglar Alarms, Watchman's Time Detectors, Electric Gas Lighting Apparatus, Telegraph Instruments, Keys, Sounders, Learners' Sets, Box Relays, etc., at Bottom Prices. Orders Filled Promptly.

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THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

Electric Light Carbons

AND

BATTERY MATERIAL.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

THE VULCAN WIRE,

HERETOFORE KNOWN AS

THE CAMPBELL LINE WIRE,

For the Electric Light, Telephone and Telegraph,

MANUFACTURED AND SOLD BY

The Campbell Electrical Supply Co., 95 Milk St., BOSTON, MASS.

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

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BRANCH, 521 DELAWARE ST., KANSAS CITY.

Sawyer-Man Electric Co.

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CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

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NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

SAWYER-MAN ELECTRIC COMP'Y. SAWYER-MAN SYSTEM. TRADE MARK

Philadelphia Office:

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BOSTON OFFICE:

No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

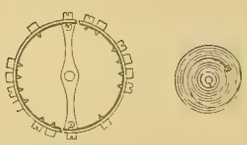
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

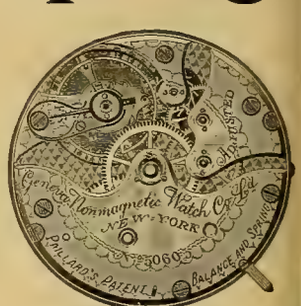
WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**



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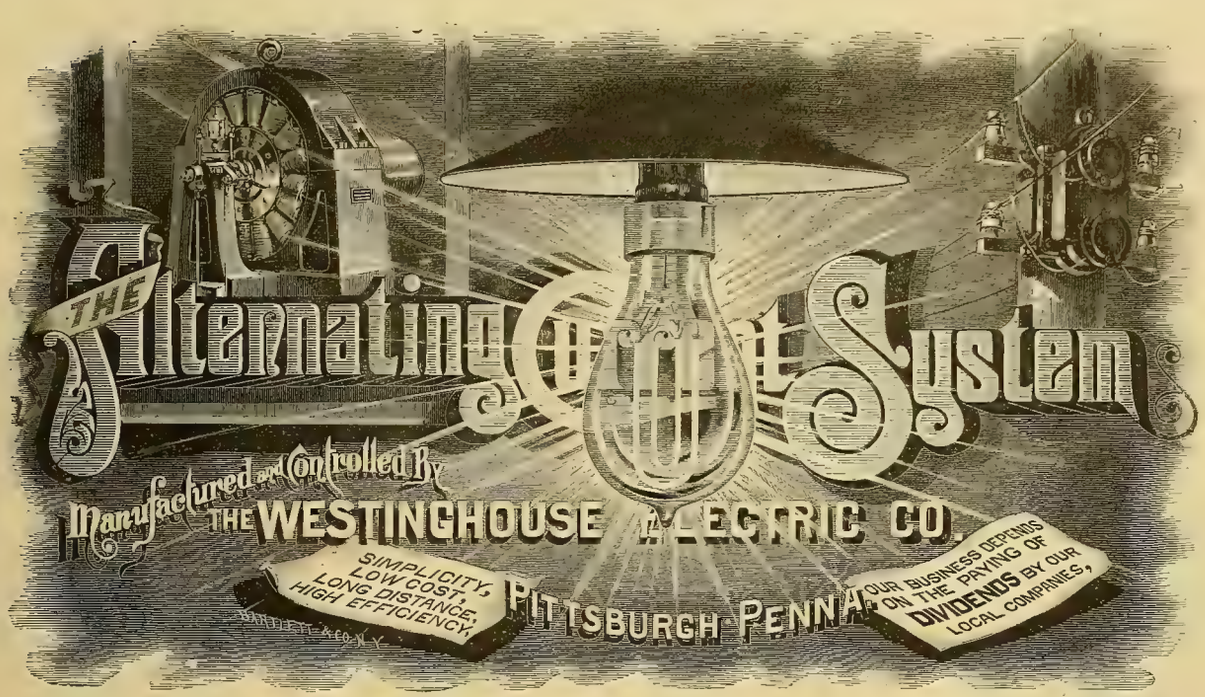

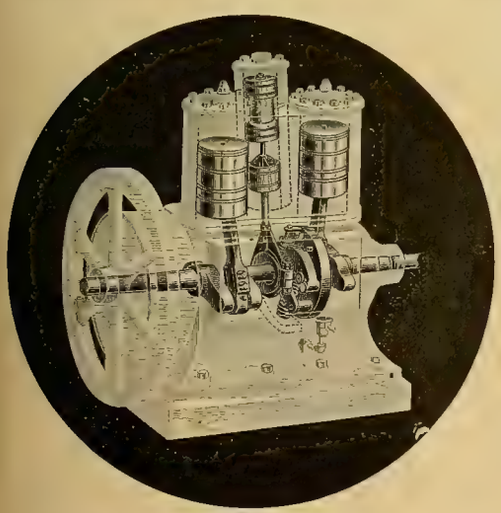

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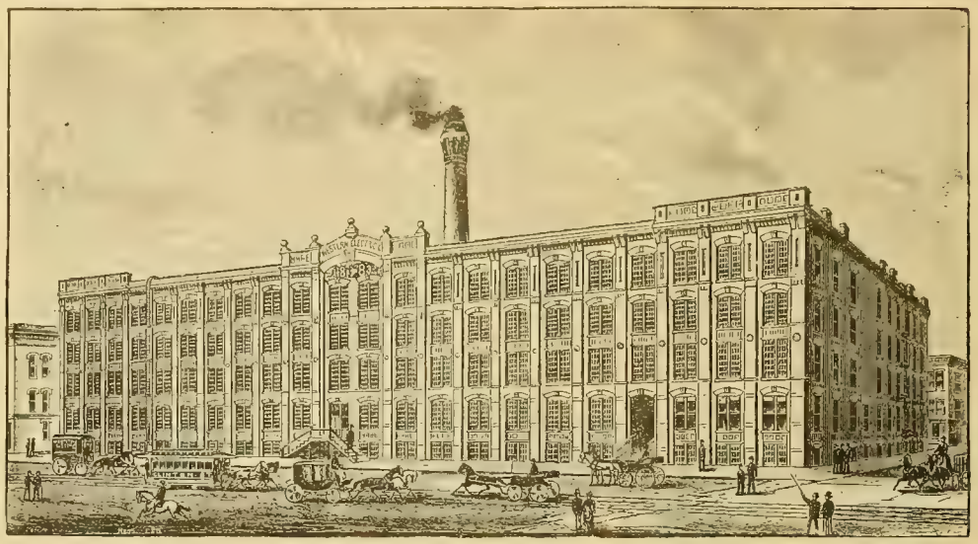

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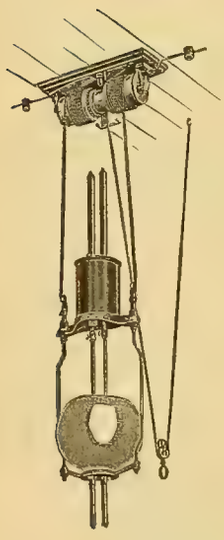

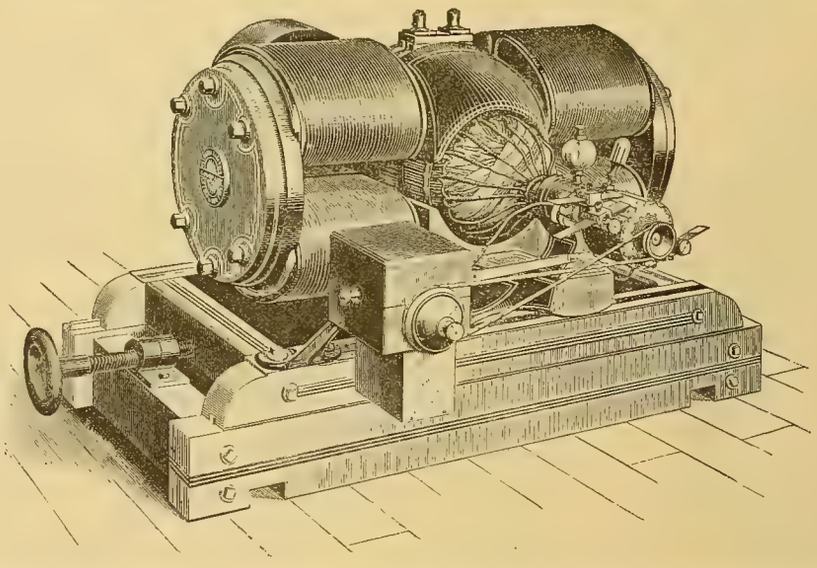

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EVERY SATURDAY

Vol. II. CHICAGO, MARCH 10, 1888. No. 10.

Methods of Protecting Ends and Splices of Underground Cables.

By W. R. Patterson.

The type of cable that is now in most common use for underground telephone work, and also to a great extent for telegraph and electric light service is one which, in general characteristics, was tried and found wanting in the earlier days of telegraphy.

The large numbers of wires necessarily massed together, the effects of retardation and the sensitiveness of the telephone current to disturbances from outside causes demanded qualities not so necessary in the usual type of ocean cable or underground telegraph conductors previously used. These requirements of compactness, low inductive capacity, isolation from outside electrical disturbances and cheapness, are met in a type of cable consisting of a group of conducting wires separated by coverings of fibrous material, usually with a saturation of insulating material, all enclosed in a flexible tube of lead, or better, an alloy offering more resistance to chemical action than pure lead.

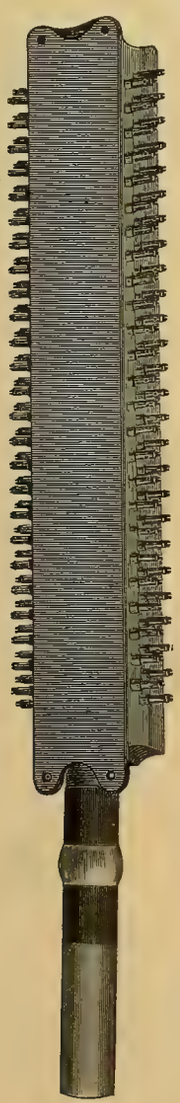

Fig. 1.

The maintenance of insulation in this type of cable depends upon the integrity of the metallic casing. No material known will saturate the fiber of the core and make it electrically waterproof. This undoubted disadvantage is much more than offset by the advantages of low inductive capacity, compactness, durability and cheapness, so that special pains may well be taken to protect it in its acknowledged weak spots. First of these are the ends where the core leaves the pipe and the individual conductors are distributed.

The style of terminal generally used by the Western Electric company for the outer end of cables in wet or damp places like pole and housetop boxes is shown in Fig. 1. It is a cast iron box with a removable face. The joint between the face and sides is planed true and is further protected by a thin strip of packing. The face of the box is held in place by brass screws tapped into the projection around the outer edge of the sides. The binding posts are screwed into hard rubber bushings which are screwed through the sides or face of the box. The binding posts project through the bushing far enough inside the box to allow the cable conductors to be attached by a nut and washer.

To attach the terminal to the cable a brass nipple with a lead sleeve soldered to one end is screwed into an opening in one end of the box. This sleeve is large enough to receive the cable pipe to which the lead end is soldered by a wiped joint. This terminal can be immersed in water with no permanent injury to the conductors, the conduction over the surface of the hard rubber bushing ceasing when it becomes dry.

Another form of terminal generally used on the office end of cables is shown in Fig. 2. In this form the sides and face are of hard rubber through which are screwed the binding posts of the pattern shown in detail in Fig. 3. This style of terminal should be filled with a melted mixture of resin and shellac after the wires have been connected.

Connection is made with the cable pipe as before; or as shown in the figure by a stuffing box through which the cable passes. This form is made with many modifications of shape and dimensions to best fit the place in which it is to be used.

The other points which need special care are the joints between different lengths of cable. This weak spot is common to every kind of cable or insulated conductor, but in this case is of special importance, because any defect in joining the pipes sooner or later involves all the conductors in trouble. The simplest splice, and best one where it can be used, is a straight sleeve splice so simple that it does not require illustration. It is made with a piece of pipe large enough to slip easily over the cable pipe and long enough to allow the conductors to be joined and insulated without making the diameter of the core greater than that of the sleeve. After the conductors are joined the sleeve is drawn back to cover them and each end soldered to the cable pipe by a wiped joint. The best way of joining the conductors in such a splice is shown in Fig. 4. A braided sleeve of cotton [not shown] is first drawn back over one of the ends to be joined. The ends of the wires are stripped and twisted together at right angles to their length. Then the twist is bent down parallel and the cotton sleeve drawn back to cover the twist.

The principal objection to this form of splice is that it offers no facilities for testing or looping out wires. For this and other reasons it often happens that this form can not be used to advantage, and to meet the various requirements special forms of joints have been devised.

Fig. 5 shows a style of T splice, made of brass with lead sleeves for soldering to the cable pipes and the wires brought out through the outlet and joined. As an insulation for the ends short tubes of glass or hard rubber are used. A cap or bell is screwed into the outlet over the ends of the wires. A number of conductors may be looped out through the small side outlet if required. This form is best adapted to joining cables which are buried permanently in the trench. For cables drawn into conduits and spliced in manholes it is not used, because it requires a considerable space in length, and in the manholes it is necessary to bend the first cables around close to the sides to give room for others. In this case if the sleeve splice can not be used, what is known as a Y is substituted. The smaller form of this is shown in Fig. 6, and requires no explanation, being used exactly as the T just described. It occupies more space vertically and less horizontally and is best adapted to manholes with curved sides.

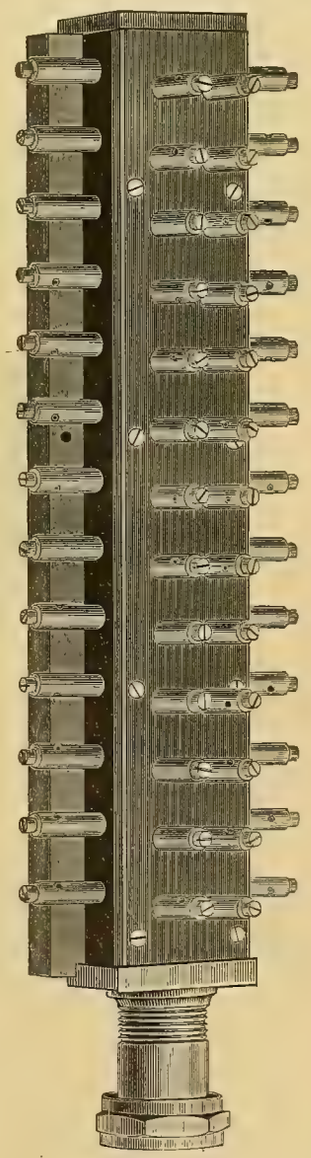

Fig. 2.

In the case of a large cable requiring a cap of over two inches to cover the joint the crowded

space often precludes the use of tongs of sufficient leverage to screw it firmly into place. Then the form shown in Fig. 7 is used, when the cap is attached to the outlet of the Y by a flange joint provided with a packing ring and held by a number of small bolts or screws This too is easily accessible and can be opened by anyone with pliers or a small wrench.

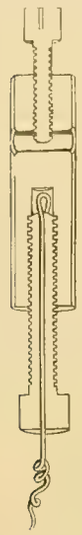

Fig. 3.

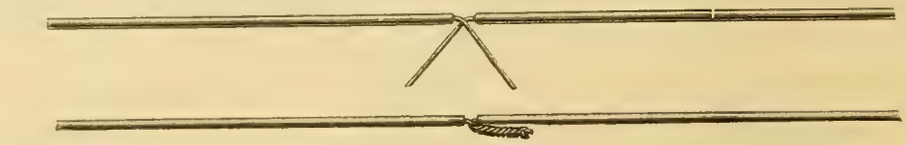

Fig. 4.

Fig. 5.

Fig. 6.

To prevent meddling in manholes containing many cables and to put the blame where it belongs in case any joint is imperfectly covered, the locking collar shown in the figure is employed.

Fig. 8 shows the splice with the cap in position and locked so as to prevent access to the bolts without unlocking the collar. Another advantage of the Y is its convenience in splicing in manholes containing water or gas. It can be lifted out of the manhole and all the work done outside, and then dropped back, thus reducing the time necessary for the men to work in a dangerous place. In case the small outlet shown in these joints is not needed for branch wires it furnishes a convenient place for the ends of the test wires, and avoids the necessity of opening the large cap and disturbing the conductors in testing for a ground.

This system of test wires is shown in outline in Fig. 9. Whenever a hole is made in the pipe, water slowly penetrates the core and necessitates repairs. If the defect can be found when it first develops there is no necessity for interrupting the circuits to make the necessary repairs. To assist in finding the defective spot is the object of this system of test wires. It consists of a number of small wires of different known lengths laid spirally around the outside of the core of conductors usually making one complete turn in about eight inches. Whenever moisture penetrates through a hole in the pipe it penetrates slowly along the core, yet more rapidly in the direction of its length than into the body of the core. If the test wires make a turn in eight inches any hole in the pipe will be within four inches of all the wires so the insulation of these wires soon falls. Now if the cable contains ten test wires of 100, 200, 300 and up to 1,000 feet, and six of them show an escape, while the four short ones do not, it indicates that the defect is between 400 and 500 feet from the end.

These test wires may be made of any lengths, and always vary by a uniform difference, which is the length of the shortest wire. They are of different colors and the color of a wire shows its relative length; thus, the white wire is always the shortest, the red next in length and so on whatever the absolute length of the white wire may be.

Fig. 7.

Fig. 8.

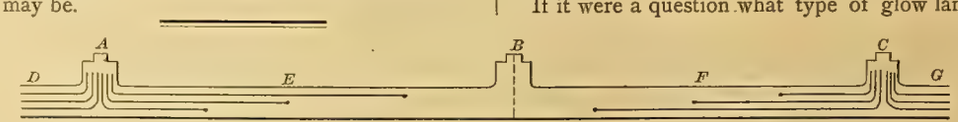

Fig. 9.

The Electric Light Illuminating company, of Topeka, Kan., has placed in the homes and business houses of that city 5,000 incandescent lights. The total capacity of the plant is 6,000 lights.

Electrical Distribution by Means of Transformers.[1]

BY J. KENNETT D. MACKENZIE.

PART I.

One of the difficulties which arises in all transmissions of electrical energy is the conveyance of a current suitable at one and the same time for any and every class of receiver. Each receiver requires, in order to work under proper conditions, a current suitable to itself, which current must have the proper proportions of potential and quantity. Now, as it is necessary, when the factor of distance is brought in, to increase the potential of the current in order to overcome the resistance due to that distance, it follows that receivers can not be used which are not capable of supporting the particular current necessary to work them at an increased distance. In the transmission of the current for glow lamps the distance is determined by the resistance of the lamps.

If it were a question what type of glow lamp is best, the reply would mainly be, that one whose resistance is the greatest — other considerations, of course, such as efficiency,— being equal. Should it be necessary to convey current

1 London *Electrical Review*, February 17.

for lighting purposes over a radius of several miles the resistance then incurred would no longer be in proportion to the e. m. f. necessary to be employed. Likewise, in the transport of power over a given distance, if each motor corresponded to a certain construction, it would be necessary to modify and vary each one, according to its position from the main source. Lastly, if it were a question of transmitting electric energy to work at the same time arc lamps, glow lamps, and motors, the current suitable for one type of receiver would not be adapted for the others; in other words, according to the nature of the receiver employed, so must be also that of the current.

It was to overcome these most serious of difficulties which stood in the way of the practical development of practical lighting and transmission of power, that Messrs. Gaulard and Gibbs grasped the idea of interposing at the receiving point between the supply wire and the receiver, a supplementary apparatus or generator, as a transformer of energy, which would deliver to the receiver with which it was connected a current proper to such receiver. The secondary generators thus in a manner prepare and modify the current transmitted from the source, and give it the necessary proportions of potential and quantity which the particular receivers supplied by them require, in order to work at the highest point of efficiency.

This idea in itself was not new when M. Gaulard commenced his experiments, Jablochkoff, Fuller, Sawyer-Man, Sir Charles Bright, and many others having previously striven to bring the matter to a practical issue; but success did not crown their efforts, for the simple reason that the basis of all their experiments was the Ruhmkorff coil more or less modified; and it was only when M. Gaulard came to the conclusion that induction apparatus constructed upon the theory founded by Faraday, and exemplified by Ruhm-

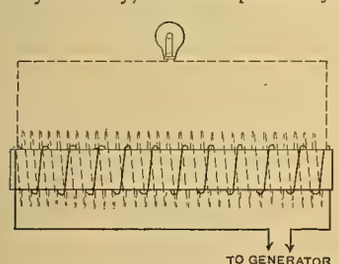

Fig. 1—Ruhmkorff Type.

korff, was unsuited for the purpose, that a step was made in the right direction.

The principles underlying transformers may be clearly seen by reference to Figs. 1, 2, 5 and 6, where what may be called the Ruhmkorff and Faraday type are shown, and the Gaulard type in Figs. 3 and 4.

In the figures illustrating this paper, primary or inducing current wires are shown in black, and secondary or induced current wires by dotted lines.

In the Ruhmkorff type the secondary is either superimposed upon the primary, as in Fig. 1, or is wound upon a core distinctly separate from, though contiguous to, the primary, and is alone acted upon by the magnetic changes set up in the core, as in the Figs. 2, 5 and 6. It is for the present purposes immaterial whether the core is polar or non-polar. In the Gaulard type the secondary is placed in an identical position in regard to the iron core with the primary, and is thus acted upon both by the core and the primary or inducing circuit, as in Figs. 3 and 4. This is one of the two principal features, wherein the Gaulard-Gibbs transformer differs from all previous ones, the other principal feature being that the metallic mass of the two circuits is equal; and in these two details of construction lies the secret of the success obtained by these gentlemen.

Other improvements in the construction of these instruments — such as making them non-polar, increasing the mass of iron to prevent loss through saturation, and other details — came afterwards, though, from the number of ingenious minds directed towards the development of the system thus practically started, such results were only to be looked for; but the following summary of what are now known as essential features in transformer construction may undoubtedly be ascribed to M. Gaulard:

1. The reduction to a minimum resistance of the primary and secondary circuits.
2. The obtaining of a maximum coefficient of induction in the two circuits with a minimum in the dimensions and weight of the apparatus.
3. The placing of the primary and secondary circuits in identical positions in respect to the core or magnetic field.
4. The proportioning of the two circuits, primary and secondary, so that their metallic mass should be equal.

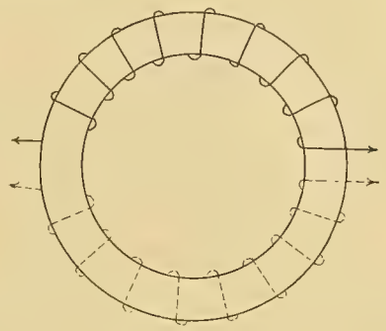

Fig. 2—Faraday Non-Polar Type.

Given these essential features, necessary for the construction of an efficient instrument of electrical conversion, it is easy to see that the mere details of construction may be varied almost *ad infinitum:* and such it appears, is now the case.

In the earlier type of secondary generator, such as was employed in the lighting of several stations on the Metropolitan Railway during the early part of 1884, the transformers were made of a wire cable (Fig. 7) composed of a central core of No. 8 B W. G. copper wire, insulated, and surrounded by six cables laid thereon, each containing 12 insulated strands of No. 24 B. W. G. This central No. 8 wire constituted the primary circuit, the 72 No. 24 wires forming the secondary circuit. The cable thus formed was wound round a soft iron wire core, suitable terminals being provided for connecting the primary to line and the secondary to the lamp circuits. As may perhaps be remembered, five stations were lighted, viz., Notting Hill Gate, Edgware road, Gower Street, King's Cross, and Aldgate, the generating plant being placed at Edgware road station. The primary conducting wire was about fifteen miles long, and was formed of seven strands of No. 16, the current in the primary line being about 11.3 amperes.

These generators were fitted with brass shields to the cores, by the lowering or raising of which more or less of the cable was exposed to the influence of the cores, and thus enabled lamps of various potentials to be employed from one apparatus. It was principally the desire to show how the potential of each column could be varied which induced M. Gaulard to make his transformers of a polar form, it being afterwards decided to make them non-polar only when the ex-

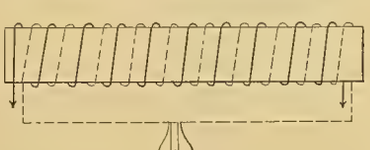

Fig. 3—Gaulard Polar Type.

igencies of actual and permanent employment of the system on a practical basis required such a change. The advantages accruing from this form were of course apparent from the first, and the matter was the subject of much discussion between M. Gaulard and myself at that time.

As is well known to electricians, the value of a current induced in a secondary circuit by one flowing in a primary, depends principally upon the four following conditions of the primary:

1. The strength of the primary current.
2. The rapidity of the interruptions or alternations of the primary current.
3. The number of spirals which compose the circuit traversed by the primary current.
4. The number of spirals which compose the secondary circuit.

The influence of the iron core upon the secondary current is for the present neglected.

In the first condition given, the secondary current increases as the square of the ampere value of the primary; and in the second it increases directly with the number of alternations or interruptions of the primary.

Conditions 3 and 4 affect the potential of the secondary circuit. It would hence appear advantageous to employ a large ampere primary current with a fewer number of alternations, since in the first case the generation of an induced current would be proportional to the square of the inducing current, and in the second case only directly proportional; but bearing in mind the formula $W = C^2 R$, C should not be greater than is consistent with practical efficiency. On the other hand, should the factor, C be kept low, an increase of secondary energy would have to be obtained by increasing the number of alternations, and this might bring about loss through heating in the iron core round which the two circuits are formed in the secondary generator, and therefore it is necessary to establish a relative proportion between each of these factors.

The multiple cable form of transformer first used by Gaulard was discarded for one in which disks of copper of the form shown in Fig. 8 were employed in some cases for both primary and secondary circuits, and many of these are still in use. The great advantage that resulted from this form of conductor was that each turn of either circuit was directly upon the insulated core, and that no superimposed layers involving loss through mutual induction between the spirals were necessary.

This question of mutual induction in superim-

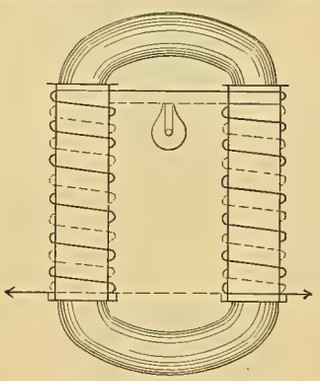

Fig. 4—Gaulard Non-Polar Type.

posed layers of wire, one with another, is of importance, and it is easy to see that, since each wire through which an alternating current is flowing serves as a medium for inducing a current of an opposite direction in the one next to it, which consequently acts against it and against the third or succeeding one, and so on, throughout the series, a loss is bound to result.

Transformers, like other electrical instruments, can be connected in several ways, but the only two that need claim notice are the series and parallel methods of connection. So much has been said and written upon this subject of late, and such peculiar statements made, that I deemed it advisable here to make a few remarks. When Messrs. Gaulard and Gibbs first exhibited their system at the Westminster Aquarium, in the beginning of 1883, only one transformer was there shown at work, and this one was consequently either in parallel or series with the dynamo. The advantages which would have resulted, were series system of connection possible, being so apparent, M. Gaulard inclined more to this method of working, and used his best endeavors towards arriving at a successful result. He knew the impossibility of directly maintaining a constant potential in a secondary circuit whose resistance was being varied while the current in the primary was kept constant (an essential feature in series working), and therefore strove so to construct his apparatus that the action of the core upon the two conductors should vary with the alternations of resistance in the secondary. This he did by altering the position or exposing more or less of the core, and some attempts were made to effect this automatically.

As has been before said, the value of the secondary circuit varies directly with the square of the current in the primary, and directly with the number of turns; other considerations, such as the magnetic influence of the core and the number of current alternations, being constant. The e. m. f. of a secondary circuit, however, is dependent upon another important factor, namely, the resistance to which it is opposed; and the following table of experiments made by M. Uzel, and published by Prof. Galileo Ferraris in his report to the jurors of the Turin International Exhibition, 1885, shows the increase of secondary e. m. f. with increase of resistance. It will be observed that the current in the secondary falls at the same time:

* Primary.		Secondary.		
A.	V.	A^1.	V^1.	R.
12.13	23.4	12.02	15.0	1.24
"	31.4	12.0	24.0	2.0
"	53.0	11.83	45.0	3.8
"	70.0	11.73	65 0	5 5
"	93.0	11.58	87.0	7.53
"	107.0	11.3	102.0	9.0
"	126.0	11.13	119.0	10.6
"	145.0	10.95	138 0	12.6

* A = amperes in primary, V = potential at poles of generator primary, A^1 = amperes in secondary, V^1 = potential at poles of secondary, R = resistance in ohms of the outer part of the secondary circuit.

It will thus be seen that the resistance in the secondary forms an all-important factor when designing apparatus for producing a required result; and a long series of experiments has established a certain ratio to be observed in order to obtain the effect sought for.

Experimentally it was found that with a certain current in the primary circuit of a given number of spirals or turns a certain electromotive force was obtained in the secondary with a given resistance, and upon these data the construction and design of apparatus employed as series transformers were based.

The work done by the primary current when traversing a number of generators is proportional to the resistance offered by these generators, or, in other words, by the counter e. m. f. opposed to the primary current by the secondaries. This necessarily is proportional to the number in use, and also proportional to the individual resistance of each secondary.

It can therefore be seen that the total energy of the primary current varies directly with the amount of work done by the secondary circuits of the generators, thus enabling complete economy in working to be obtained.

The economy resulting from this system of working in series would be substantial were it also possible to ensure constancy of potential at the same time between the poles of the secondary with a varying resistance in that circuit. The difficulty is, that the e. m. f. increases in the same ratio as with the resistance; and this, consequently, points to the fact that transformers, when connected in series, must supply lamps also in series, or, in other words, the external secondary circuit must diminish in resistance as the lamps are turned out, instead of increasing, as is the case when the lamps are in parallel. More than two years ago I made some experiments upon this subject with Mr. Bernstein, the results being perfectly satisfactory so far as regulation went. Another way out of the difficulty, if series transformers and lamps in parallel are to be used, is by the employment of subsidiary resistances, or "choking coils," as they are called, which take the place of the lamps when turned off. Fig. 9 shows this in a theoretical diagram.

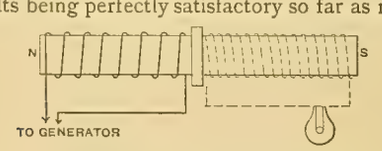

Fig. 5—Fullar Poler Type.

With series transformers and series lamps, all danger from fire risk is reduced to a minimum. No main fusible cut-out at the transformer secondary poles need be used, for, as has been before said, if a short circuit occurs, the potential immediately drops, so that the flow of current is consequently that due to the resistance of the secondary helix, including the short circuit. I have frequently run series transformers on short circuit, and no heating has resulted, the potential at the terminals being imperceptible on a voltmeter, whilst the current indicated by an ammeter in the short-circuit was solely that due to the resistance of the ammeter and the secondary circuit of the transformer itself.

Another difficulty that lies in the way of working transformers in series is that experienced in maintaining a constant current on the line; and, although many attempts have been made to do this automatically while employing alternating current machines, no great success has as yet been attained.

Having briefly reviewed the system of working transformers in series, and shown the objections inherent to that method, I will now refer to the parallel system — upon which all present installations are based — treating the subject in as practicable a manner as possible.

At the outset one important feature, inseparable from all parallel systems of transmissions of energy, may be mentioned, especially since it shows how, by the use of transformers, difficulties may easily be surmounted.

This is that the fall of a potential along a line varies in proportion as the current is increased when changes are made in the load. The difference of potential between the source of supply and the extremity of the line is small when the current is small, but very considerable when a heavy current is used: and, consequently, if the lamps near to the source be kept at a constant pressure, those far off will vary according to the intermediate load. In direct working this objection can only be met by employing a conductor of such size as will render the resistance of that conductor of no account, but then all considerations of economy will have to be abandoned.

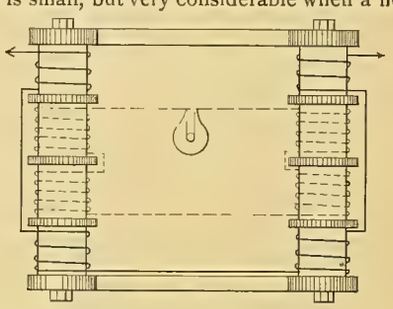

Fig. 6—Fuller Non-Polar Type.

This difficulty has been experienced in all large direct supply works, since the fall of potential depends upon the ratio that the amount of loss on the line itself bears to the maximum amount of work carried by the line, this in many cases being quite 20 per cent. By employing a high potential, however, the current to represent a given amount of energy may be so reduced that this ratio may be made as low as 1 per cent. per mile; and consequently transformers in parallel are capable of maintaining practically the same potential in their secondary circuits, irrespective of their position upon the line, or of the variation of the load at intermediate points. The following figures may make this matter clear:

Suppose a dynamo giving an output of 150,000 watts, equal to, say 1,500 amperes and 100 volts. If the conductor be proportioned so that one square inch of sectional area be used for every 1,000 amperes, the size of the conductor necessary will be 1.5 square inches. This conductor having a resistance of about .028 ohms per mile (neglecting heat resistance), the loss per mile on the line will be $1500^2 \times .028$, or 63,000 watts — equal to about 42 per cent. of the total output of the dynamo per mile.

By the use of transformers, however, the same energy could be transmitted over the same distance with a very different percentage of loss. The output being 150,000 watts, may be represented by a current of 50 amperes and 3,000 volts. The resistance of a cable required to carry this current, calculated on the same basis, would be about .864 ohms per mile, and the loss, therefore, would be $50^2 \times .864$, or 2,150 watts — equal to about 1.4 per cent. of the total load per mile.

(*To be continued.*)

The Elements of Electric Lighting.

By Philip Atkinson, Ph. D.

Number XXXII.

The Bernstein Carbons.—These are made from silk ribbon of the finest texture, woven into a hollow cylinder of the required size, from which sections of the proper length are cut, which are immersed in a thick syrup of cane sugar till saturated, and subsequently in melted paraffine; they are then bent on shapes into the horse-shoe form, placed in graphite molds of the same shape and imbedded in graphite powder,

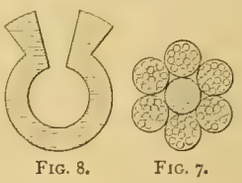

Fig. 8. Fig. 7.

and baked for 24 hours. The subsequent flashing process is the same as that for the Lane-Fox carbons.

These are the only carbons made from an animal substance, and with a hollow structure; and the advantage claimed for this structure is increase of surface and consequently of radiating capacity with a given degree of resistance.

More or less of the details of the various processes of manufacture are trade secrets, as in the case of arc light carbons, and in some instances the whole process is kept secret, as in the manufacture of the Siemens-Halske and also of the Woodhouse-Rawson carbons.

As the length and diameter of the filament determines to a great extent its electric resistance and illuminating power, it varies according to the e. m. f., current, and kind of carbon employed, so that exact figures can not be given. The Swan filament, as we have seen, is about 5 inches long and .005 of an inch in diameter, and may be taken as representing approximately the average dimensions required for the ordinary 16 candle power lamp.

The shape of the filament varies, the horse-shoe form being the most common; the Swan filament, as already mentioned, is a flat spiral, and the same form is adopted for the Brush, while the Maxim resembles a capital M with the angles rounded off. The Sawyer-Man filament resembles a figure 8. Fig. 70 shows an Edison lamp and Fig. 71 a Westonb oth with horse-shoe filaments, and Fig. 72 a Weston with corrugated filament.

The cross-section of the filament is also a point of considerable importance, determining not only its strength in resisting jars, concussion, and high temperature, but also its illuminating power. As the rectangular form gives greater surface than the circular with the same cross-section, the illumination with a given length is greater, but this can be compensated in the circular form by increasing the length; this increases the resistance and consequently the e. m. f. without increase of current. Hence the same illumination can be obtained from the round filament as from the rectangular with greater economy of current. The hollow circular filament, like the Bernstein, gives the maximum of surface with the minimum of substance in cross-section, and hence, as we have seen, the maximum of illumination with the minimum of resistance, and also the maximum of strength in proportion to substance and resistance. Hence, if reduction of resistance in proportion to strength and illumination is desirable, either the rectangular or the hollow circular form is preferable, but if increased resistance in propor-

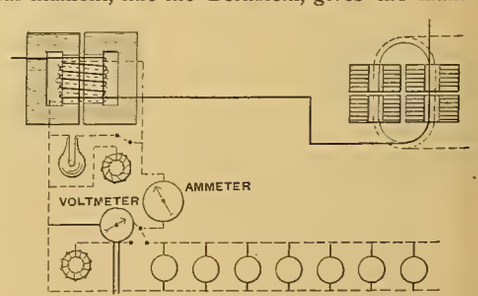

Fig. 9—Sharp & Kent Choking Coils.

tion to strength and illumination is desired the solid circular form with increased length is preferable.

The filament is in all cases made largest at the points of attachment, either in the form given previous to carbonizing, or by the subsequent deposition of carbon on the extremities or their insertion into small perforated carbon cylinders. This is necessary for the purpose of better attachment to the platinum wires, but more especially to reduce the resistance and hence the strain on the filament at the points where the current enters and leaves, and to increase the strength where liability to fracture is greatest. The attachment of the filament to the platinum wires is accomplished by different methods; that of the Edison, by copper plating, has been already mentioned. The Lane-Fox filaments are cemented into short carbon cylinders, to which also the platinum wires are similarly attached, with a cement made of India ink and plumbago. The attachment of the Cruto filaments is effected by their insertion into tubes formed on the ends of the platinum wires, and the subsequent deposition of carbon by the electric process on these junctions. The Weston filament terminates in carbon cylinders, nickel plated, each about $\frac{3}{16}$ of an inch in length and $\frac{1}{38}$ of an inch in diameter, around which are wound in spirals the flattened extremities of the platinum wires. This method is also used with the Bernstein filaments, and is attributed to W. Siemens.

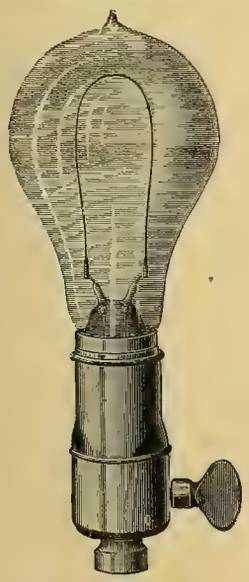

Fig. 71.

The average durability of filaments is estimated at from 800 to 1,000 hours or from three to four months, with an average use of from eight to nine hours a day. While there is no actual consumption such as occurs with arc light carbons, there is a certain amount of wastage caused by the incandescence, infinitesimal particles of carbon being given off, probably in the form of vapor, and being attracted to the glass in consequence of the difference of potential between it and the filament, adhere to the sides of the globes, producing a certain degree of blackening.

It has been observed by Edison that with the constant current this wastage is greater in one-half of the filament than in the other. This may be accounted for by comparing the positive and negative halves of the filament to the positive and negative carbons of an arc light pair, and since the consumption of the positive carbon by its electric conversion into vapor is far in excess of that of the negative, the same process, which we may reasonably assume occurs in the filament on a very limited scale and proceeds from the same cause, will account for this unequal wastage. It is also well known that the durability of the filament is in proportion to the perfection of the vacuum, the residual air producing slight oxidation during incandescence, which, as in the arc light, would be greatest on the positive side.

But besides the reduction from wastage, the intense molecular action during incandescence, the alternate heating and cooling, and probably also a certain species of electrolysis, which has been observed in solids as in liquids, reduce the structural tenacity and are the chief causes which eventually result in the rupture of the filament. This is further shown by the fact that the durability of the filament depends largely on the amount of current employed. Increased current produces increased light but shortens the durability, and it becomes an important economic

Fig. 70.

problem to determine just what amount of current to employ with filaments of a given size and resistance, especially as the rupture of the filament practically terminates, the life of the lamp, since filaments cannot, like arc light carbons, be replaced with new ones in the same lamp, on account of the hermetical sealing and exhaustion of the globe. Taking four of the leading incandescent systems as fairly representing the best practical experience in this method of electric lighting, we find that the results of numerous careful tests show, for the 16 candle power lamp, an average e. m. f. of 91.91 volts and a current of .71 of an ampere; which gives 4.07 watts per candle power as the rate of working found to be the most efficient and economical. It is found also by a similar series of tests that the flashed filaments are the most durable and give, on an average, a third more light than those not so treated.

Construction of the Incandescent Lamp.—As the main features of the incandescent lamps are very similar, we may take the latest Weston 16 candle lamp, Figs. 71 and 72, as a fair sample of their construction. The glass globe or bulb is about 3½ inches long by 2¼ inches in diameter. The filament, of the horse shoe form, is attached to the platium wires, as already described, and these pass through two

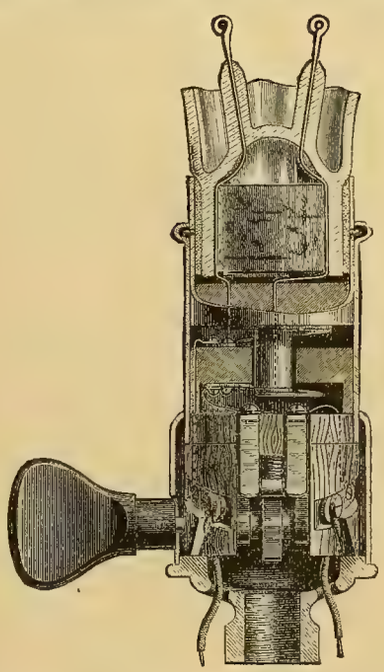

Fig. 73.

little tubes, as shown in Fig. 73, at the inner closed end of a hollow glass stopper fitted to the neck of the bulb, the glass being fused round them. The neck is wide enough to admit the filament into the bulb without compression, and after its introduction the glass is fused around the stopper. A short glass tube projects from the broad end of the bulb, through which the air is exhausted from the interior, after which it is fused, thus sealing the globe hermetically.

The outer end of the tubular stopper is fitted with a wooden insulating plug, which has a central projection about ⅜ of an inch long and ¼ of an inch in diameter, through which a copper wire, connected with one of the platinum wires, passes, and is attached to a brass screw at its outer extremity, while a copper wire from the other platinum wire connects with a metal washer attached to the broad part of the plug, so that the wires are insulated from each other. A brass collar, connected to the neck outside, fits into a brass tube about 2 inches long and 1 inch in diameter, connected to the bracket or chandelier. In this tube are two metal springs, one of which terminates in a washer, which slips over the projection of the insulating plug, and makes contact with the metal washer on the broad part, while the other makes contact with the screw at the extremity of the projection. These springs are insulated from each other and connected with the electric circuit, so that the current from one must pass through the filament to reach the other. The circuit is opened and closed by a hinged metal contact piece, operated by an insulating handle, the closing being effected by the pressure of this piece against a pair of springs so connected with the springs already mentioned as to complete the circuit, and the opening by a reverse turn of the handle, which breaks the contact, so that the lamp is lighted or

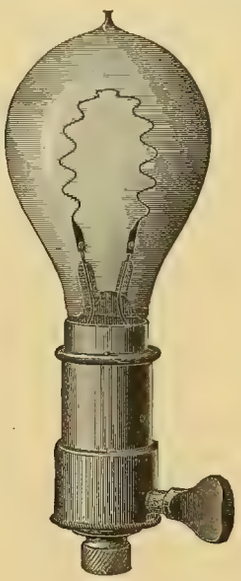

Fig. 72.

extinguished by a quarter turn of the insulating handle, like a gas jet. A lozenge shaped piece of metal attached to the handle, as shown, presses down the hinged contact piece to close the circuit, and holds it in position, and a spiral spring lifts it when released and opens the circuit, the whole apparatus being inclosed in the brass tube mentioned above.

The lamp bulb is held in connection with this tube and inclosed apparatus by little projections on the brass collar attached to its neck, which slip into a groove in the lower end of the tube, so that when a filament breaks it is but the work of a moment to remove the defective bulb and replace it by a new one, the only loss being the bulb and filament, the other apparatus remaining permanent, and the connections with the new bulb taking place by contact without further manipulation as soon as it is placed in position.

Rebates on Pencil-Signed Certificates.

W. H. Harding, secretary of the National Electric Light association which was recently in convention at Pittsburgh, writes that if the members whose certificates were signed in pencil will forward them to him at 11 South street, Baltimore, Md., he will correct the error and secure for them the rebate they are entitled to.

The Peruvian government has invited electrical companies to submit propositions for the introduction of telephones into that country.

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IT is reported that Mr. Edison has recently ordered an Edmondson calculating machine for his new laboratory at Orange, New Jersey. This machine is said to perform addition, subtraction, multiplication and division, dealing with numbers of almost unlimited amount.

SIR Douglas Galton, in a recent lecture in London, suggested that by the use of kites and balloons the electrical condition of the air which he assumed accounted for the fogs in the metropolis might be disturbed and rains might be induced. If such means could be employed to dispel, even in a measure, a single London fog, its financial importance could hardly be overrated as during the reign of the yellow fog, business is almost suspended.

AT the United States government observatory on Pike's Peak, Colorado, a series of experiments was inaugurated on the 29th ult. with the instrument variously known as the heliograph, heliostat, or heliotrave, by which messages are telegraphed by intermittent flashes of sunlight.

The instrument consists of two parts, each mounted on a separate tripod. The first is a mirror 6x4 inches, with a hole in the center, so hung as to turn easily in any direction, a sight on an extension arm enabling the operator, looking through the hole, to direct the reflected ray to any point required. The same instrument has also another mirror for use when the sun is at the operator's back.

On the second tripod is mounted a small shutter opened by pressure on a button and closed by a spring, by means of which the light is alternately admitted to the mirror or shut off, thus producing the flashes, which by their different length indicate the letters acording to the Morse alphabet.

The line had to be abandoned during the winter as it was found impracticable to keep it open, but experiments are now made daily at stated hours. To the ordinary observer it resembles an unusually brilliant star or a small electric light, and a skilled eye can read the message without a telescope. For short distances it is said to be superior to the electric telegraph.

THE application of the electric motor to the fire engine is an invention of great importance. The advantages of the electric fire engine are obvious. It is much lighter than the bulky steam engine; the boiler is disposed of and consequently it can be hurried to the scene of the fire more rapidly. When it reaches the spot it is instantly ready for work. It is merely necessary to connect the wires of the motor into the electric circuit. There is no waiting for steam; no waiting for the coal tender. Compared with the steam engine it is almost noiseless so it does not add to the general confusion. The use of engines of this kind would in many cities be restricted to the business sections, but even if confined to a limited district the employment of the engines of this kind would doubtless prove profitable. The electric light wires are being extended daily and the district in which the electric fire engine can be operated is widened. In many cities where the pressure of water is depended upon to throw a stream upon the fire it is frequently found that a delay of several minutes elapses before the force is found adequate. If the fire service in such places was supplemented by two or three small engines of this kind, which may always be depended upon, serious conflagrations so often caused by delay of water pressure could be prevented. There is another similar use for which the electric motor is proposed. It is asserted that the most complete protection for manufactories could be afforded by the employment of pumps and electric motors.

THE attempt of M. Freycinet to substitute for the metre a new unit, is ill advised and not likely to meet with favor among scientists, as it would disturb the c. g. s., system just as it has become fairly established. This system was adopted unanimously by the Paris Electrical Congress in 1881, and is now accepted and in common use by electricians and scientists throughout the civilized world; furnishing a common basis of measurement, promptly comprehended, and equally familiar to people of all nations. The unit of length or of weight established by custom for commercial purposes may vary, but the centimeter and the gramme remain constant in Japan or America, in England, France or Germany.

The substitute for the metre, proposed by M. Freycinet, is the distance through which a body, in the latitude of Paris, falls in one second in *vacuo*, while the metre represents $\frac{1}{10\,000\,000}$ of a quadrant of the earth in the meridian of Paris. The object in either case is to secure an invariable standard by which measurements can always be corrected, and concerning which there can be no misunderstanding; and as the established standard is just as invariable as the proposed one, the advantages of a change are not apparent, unless they are to be found in the greater length of the proposed unit, which would make the fractional divisions of hundreths and thousandths larger and more convenient, and also give the unit of length a definite relation to the unit of time, so that one could be derived from or corrected by the other. But the advantages thus gained are of doubtful utility as compared with the disadvantage of disturbing a well established system. When certain conceptions of space, weight and time become fixed and habitual, and the literature of nations adapted to them, they are as difficult to change as the language of which they form a part, and such change should not be attempted except for good and sufficient reasons, even if the change should be an improvement.

IT is a trite remark that "electricity is still in its infancy." This was true some years ago, but we would suggest that since the little fellow may fairly date his birth a hundred years back, and has grown with amazing rapidity during the last quarter century, he may now be fairly entitled to be dignified as a youth rather than an infant. Fifty years ago he was confined to the electric nursery known as the laboratory, and fed with a spoon on scientific milk by the scientific nurses known as professors. About 1840, much to the astonishment of his nurses and every one else, he ran away and went to Washington, making the trip from Baltimore on a wire road of his own invention, and carrying a message to the president. This escapade demonstrated his ability as a messenger boy, and he was immediately installed in that capacity, and his wire roads, on which he alone could travel, were extended in every direction. In 1858 his nurses, Morse and Field, thought him capable of a sea voyage, and sent him across the Atlantic with a message from the president to Queen Victoria; he made the trip and delivered the message successfully, but the over-exertion, the sea air, and, especially, an injudicious bath in the salt water, proved too much for him, and he didn't attempt another such voyage for three or four years, confining his marine work to short voyages, in which he gained the experience necessary for an Atlantic messenger boy, in which position he was eventually duly installed, and fulfilled its duties with his accustomed ability.

His guardians had long contemplated educating him as a machinist, and after a few years training he became so proficient, that, in 1867, he astonished the world with his wonderful dynamo, with which he produced artificial sunlight which drove gas completely into the shade. His next greatest invention was the electric motor, which he harnessed with the dynamo in such a manner that the former should furnish the power while the latter did the work. And now we find him driving the machinery of great factories, drawing railroad cars, and becoming the rival of old steam himself, who sits by the fire quietly, smoking his pipe, and with infinite self-complacency saying, "Go it, young fellow; you think yourself very smart, Mr. Electricity, but if it wasn't for me you couldn't do all these fine things."

But our young chap has also an æsthetic and gentler side to his nature; and in his spare moments he invented the telephone, through which he whispers soft nonsense into the ears of young ladies and talks business to their papas and big brothers. He is also the inventor of the electrotype and photo-engraving processes, which have made such a wonderful improvement in the products of the printer's art.

And still, from sheer habit, we call this strapping young fellow an infant, and forget that he has attained the bloom and vigor of young manhood.

THE board of managers of the Chicago Electric club, recently arranged for a general discussion of the relative merits of the alternating and continuous currents for central station lighting, and secured the promise of some of the leading electricians of the west to enter the list. The programme as arranged included the appended names;

H. Ward Leonard, of the Edison company, on the continuous current.

M. M. M. Slattery, of the Fort Wayne Jenney Electric Light company, on the alternating current.

E. P. Warner, of the Western Electric company, on the continuous current.

F. B. Badt, of the United States Electric Lighting company, on the alternating current.

The foregoing, as might be inferred, is an incomplete programme; it is confidently expected that others will be found to add their arguments in favor of one side or the other.

Mr. Leonard inaugurated the discussion at the meeting of the club last Monday evening, as will be seen by reference to the paper which appears in this issue together with a full report of the subsequent discussion.

The next paper will be read by M. M. M. Slattery at the next meeting of the club, Monday evening, March 19th, the formal title being, "Recent developments in and advantages of the alternating system of distribution over the continuous current system."

The announcement to club members that Mr. Leonard would read a paper, brought forth a large attendance, and Mr. Leonard was paid an indirect compliment, but nevertheless one of high degree, in being greeted by the largest assemblage of members that has gathered at any stated literary meeting of the club since its origin, and further in both the reading of the paper and the discussion, succeeded in holding the undivided attention of those present until an hour far prolonged after the usual time for adjournment. In fact, the preliminary business meeting was practically done away with, as it consisted of but little more than the reading of the minutes of the preceding meeting.

It must be conceded, after a perusal of Mr. Leonard's paper, that it is an able presentation of the continuous current side of the discussion, and that in the main, he is fair toward the alternating current.

The papers on this subject will prove interesting, valuable and timely, and we predict for them a most careful study by those who can not find it possible to be present at the meetings at which they are presented.

The Comparative Value of the Continuous and the Alternating Current Systems for the Commercial Distribution of Electricity.[1]

By H. Ward Leonard.

There exists to-day a great deal of uncertainty in the minds of many persons interested in the distribution of electric energy as to the comparative value of the continuous current three-wire system and the alternating current converter system; and as the published statements relative to these two systems have apparently greatly exaggerated certain advantages and disadvantages of the one system and the other, I will endeavor to institute what I consider as fair a comparison as possible between the two systems, using the best data at my command, and giving due weight to the several factors necessary in a general system for the distribution of electric energy on a commercial scale.

In considering the comparative value of these two systems, let us compare them with each other upon the following points, which I consider the vital ones in a general supply system of electric energy:

First. First cost.

Secondly. Economy, efficiency and depreciation.

Thirdly. Reliability.

Fourthly. Variety and value of the possible sources of revenue.

Fifthly. Safety to life.

Sixthly. Effects upon existing property.

First, cost and economy.— This is a feature which is subject to variations which are not similar in the two systems, and it may be well to give some general explanations of the cause. In a three-wire system the principal items of cost are the generators, main conductors and inside wiring. In the alternating system the main items of cost are generators, primary circuit, converters and secondary circuit.

The cost of the generators is as far as I am able to judge by inspection and comparison of prices, about the same. At any rate, any possible difference in this respect must necessarily be but slight in its influence on the total cost of which it becomes a very small factor. We therefore come to a comparison between the cost of the feeders, mains and inside wiring of the three-wire, and the cost of the mains, converters and inside wiring of the alternating system.

The cost of the conductors transmitting a given amount of energy at given loss for a given distance varies, generally speaking, inversely as the square of the initial electromotive force employed. For instance, if the e. m. f. of one system be 1,000 volts, and that of another be 110 volts, the cost of conductors for the latter under similar conditions would be to the cost of the former as 1,000,000 ($1{,}000^2$): 12,100 (110^2); i. e., as 82 : 1.

In the three-wire system double the e. m. f. of the lamps is used, and the practical effect is the same as if the lamps were operated in series as far as the two outside conductors are concerned.

In order to secure complete independence of each individual lamp, a third wire, called the neutral wire is run. This wire has a potential midway between those of the two outside wires, and in practice only carries the amount of current represented by the difference between the number of lamps burning on the two sides of the system.

Since the three-wire system has practically two lamps in series, and since the resistance of the two lamps in series is four times that of two lamps in multiple arc, it follows that, with the same number of lamps, the resistance of the lamp circuit is in the three-wire system four times that of the two-wire system. Therefore, for the same percentage of loss due to the resistance of the conductors, the size of the wires for the three-wire system need be only 25 per cent. the size and cost of those for a two-wire system. The neutral wire, if it be of the same size as the outside wires, would add one-half more to the cost, making the total cost, instead of 25 per cent., 37½ per cent. of the two-wire system. In practice the size of the neutral wire is less than that of the outside wires in the feeders, and the cost is thereby reduced so that in practice the cost of conductors is 33 per cent., or one-third of the cost of the two-wire system.

We saw that the cost of a conductor for a 110 volt two-wire system, and a 1,000 volt converter system was as 82 is to 1. It is now evident that by using the three-wire system this ratio becomes as 27.5 is to 1.

The three-wire system is not of course limited to the electromotive force quoted. The Edison company operate dynamos of 1,200 volts in a three-wire system for their municipal system. The standard three-wire system of to-day is limited by the difficulty in manufacturing lamps of much higher voltage than 110. When the time comes, and it seems near at hand, that lamps can be had of double the voltage of those, the cost of conductors of the three wire system will be one-fourth of what it is to-day; or in other words, existing conductors will be able to supply four times as many lamps as at present, and at the same loss; also, an increase in the economy of the incandescent lamps would reduce the cost of conductors proportionately, and we can, of course, expect to see very great improvements in this direction.

It is evident, therefore, that the cost of conductors in the three-wire system will be reduced by inevitable improvements in the lamp itself to but a small fraction of its present cost.

Now let us look at the alternating system under similar conditions. Outside of the generator the converter is the principal item of cost, the cost of conductors being slight in comparison, as we will see later. An increase in the voltage of the lamps would be of no benefit whatever, and an increase in the economy of the lamps would result in a proportional reduction in the cost per lamp. Let us suppose that the voltage of existing lamps be doubled, and the economy increased 25 per cent., both of which results are likely to be seen in a very few years, if not sooner. The cost of conductors for the three-wire system would be reduced 80 per cent. and the cost of converters would be reduced 20 per cent. or, in other words, existing three-wire conductors would be able to supply five times as many lamps as at present, an increase in capacity of 400 per cent. and existing converters would be able to supply 25 per cent. more than at present.

So much for the probable reduction in first cost consequent upon improvements in the economy of the lamp itself, the only place in any incandescent system where much increase in economy can be expected, as existing devices are all claimed to, and most of them do show an individual efficiency of 90 per cent and upwards.

Let us now examine the comparative cost, as these systems exist to-day. In order to do this, it becomes necessary to determine the cost of conductors under the varying conditions met with in practice; and this can be conveniently done by applying the following formula deduced by the writer, the accuracy of which has been tested by practical use for about two years:

Let TCP be total candle power.

Let D be the mean distance current travels (one way).

Let L equal price per pound of copper (in cents).

Let V be volts lost in conductors (both ways).

Let E be e. m. f. of lamps.

Let CHP be candles per electrical horse power.

$$\text{Then } \$ = \frac{\text{TCP} \times \text{D}^2 \times \text{L}}{\text{V} \times \text{E} \times \text{CHP} \times 1{,}000}$$

For the three-wire system 1-3 of this.

Before proceeding to apply the formula, let us clearly understand that with a continuous current the loss in conductors is exactly proportional to the amount of energy they transmit; i. e., any variation in the load causes a proportional variation in the loss in conductors.

With the alternating current this is not the case, the decrease in the energy transmitted resulting in but a slight decrease in the current. Thus, with a continuous current the loss in conductors under conditions of one-quarter load is one-quarter what it is at full load, but with the alternating current the loss in conductors at one-quarter load is probably 75 per cent. of what it is at full load. However, as this conclusion is based mainly on theoretical grounds, I will, in comparison, grant that the alternating current will be as efficient in this respect as the continuous current.

Careful examinations of the load diagrams of some 50 Edison central stations, show that throughout the run the average load is from 33 to 40 per cent. of the maximum load; i. e., if the loss in conductors is 10 per cent. when the full load is on, the average loss throughout the whole time the plant is supplying light is but 4 per cent.

Table 1 shows the maximum loss expressed in volts, the corresponding maximum per cent. of loss, the corresponding average per cent. of loss, and consequently the average efficiency of the system of conductors:

Table I.

System.	Three-wire System.			1,000 Volt Alternating Current System.		
Maximum loss in volts	12.5	20	30	25	50	100
Maximum loss in per cent.	10	15	20	2.5	5	10
Average loss in per cent.	4	6	8	1	2	4
Average efficiency	96	94	92	99	98	96

These two tables show the individual efficiency of the different portions of the two systems, and the total efficiency from the driving belt up to and including the portions named. I have granted in all cases for the converter system an efficiency of 98 per cent. for the primary, and 99 per cent. for the secondary conductors. With a commercial efficiency of 90 per cent. for the generator, and 95 per cent. for the converter, which is sometimes claimed for them by some, the total efficiency is 82.9 per cent. With a commercial efficiency of 85 per cent. for the generator, and 90 per cent. for the converter, which is believed by others to be liberal, the total efficiency is 74.2 per cent. In the three-wire system we have assumed an efficiency of the generator of 92 per cent., which result is obtained by every maker of a first-class dynamo of this type, and an efficiency of 99 per cent. for both the mains and the inside wiring, both of which portions of the system are in practice calculated for a maximum loss of 2 per cent.

The maximum loss in the feeders in table number 2, is made 10, 15 and 20 per cent., with a corresponding average loss of 4, 6 and 8 per cent., and an efficiency of 96, 94 and 92 per cent.

Table II.

Alternating Current Converter System.

	Indv	Tot'l.	Indv	Tot'l.	Indv.	Tot'l.
Efficiency of generator	90	90	88	88	85	85
Efficiency of feeder	98	88.2	98	87.2	98	83.3
Efficiency of converter	95	83.8	92	79.3	90	75
Efficiency of services and inside wiring	99	82.9	99	79.5	99	74.2

Three-Wire System.

	Indv.	Tot'l.	Indv.	Tot'l.	Indv.	Tot'l.
Efficiency of generator	92	92	92	92	92	92
Efficiency of feeder	96	88.2	94	86.5	92	84.6
Efficiency of mains	99	87.3	99	85.6	99	83 7
Efficiency of services and inside wiring	99	86.4	99	84.7	99	82.9

Assuming the highest efficiency claimed for the alternating current generator, and assuming the generator is as efficient as a continuous current generator under conditions of partial load—which is not likely—and assuming that the converter has the same efficiency under partial load as under full load—which we know cannot be—we still are met with the fact that the three-wire system with a maximum loss of 20 per cent. in the feeders has as high an efficiency as the converter system, allowing it every possible claim, and that the three-wire system as usually installed, with a maximum of 10 per cent loss in feeders has a superior efficiency of from 4 to 12 per cent. over the alternating current converter system

[1] Read before the Chicago Electric Club, March 5, 1888. The first of a series of papers upon the subject, "The Continuous Current *vs.* The Alternating Current," before the club.

To return now to the question of first cost, assuming the cost of copper at 16 cents per pound, I have figured the cost of copper conductors for feeders for 16 candle power; 50 watt lamps for distances of 1,000, 2,000, 3,000, 4,000, 5,000 and 6,000 feet, with an average loss in conductors of 4, 6 and 8 per cent. for the three-wire system, and 2 per cent. for the alternating system with 1,000 volts initial e. m. f.; cost is expressed in dollars and decimal fractions thereof.

TABLE III.

Cost of Copper for Three-Wire Feeder, per 16 c. p. lamp (50 Watts, 110 volts.) Copper at 16 cents per lb.

Distances	1,000	2,000	3,000	4,000	5,000	6,000
12.5 volts maximum loss equals 5 volts average loss, which is 4 per cent	.266	1.064	2.394	4.256	6.65	9.576
20 volts maximum loss equals 8 volts average, which is 6 per cent	.1615	.646	1.453	2.584	4.037	5.812
30 volts maximum loss equals 12 volts average, which is 8 per cent	.1077	.430	.969	1.723	2.69	3.87

Cost of Primary and Secondary Circuits and Converters for 1,000 Volt Alternating Current Converter System, per 16 c. p. lamp., at varying distances.

Distances	1,000	2,000	3,000	4,000	5,000	6,000
Primary	.0213	.085	.191	.340	.530	.764
Converter	3.000	3.000	3.000	3.000	3.000	3.000
Secondary	.240	.240	.240	.240	.240	.240
Total	3.2613	3.325	3.431	3.580	3.770	4.004

I have also calculated the cost of copper in the mains for one 16 candle power lamp on the basis of a distance of 800 feet between feeder terminals in the three wire system and a maximum loss of 2 per cent. and find it to be thirteen cents. Also the cost of services and inside wiring in the three-wire system on basis of an average distance to lamps of 100 feet, and 2 per cent. loss, and since the full benefit of the three-wire distribution cannot be attained in the inside wiring, have assumed the saving of one-third over the two-wire system instead of the two-thirds saving effected in cases where the full benefit can be attained. On this basis the cost of copper for services and inside wiring is six and one-half cents per lamp.

In the alternating current converter system I have assumed the cost of converters recently quoted by Mr. Stanley, the electrician of the Westinghouse company, in a paper before the Boston Society of Arts. This figure is three dollars per lamp. I have calculated the cost of copper per 16 c. p. 50 volt and 50 watt lamp with an average distance to the lamp of but 75 feet, and with 2 per cent. loss, and found the cost of copper to be 24 cents per lamp. With an average distance of 100 feet, as was assumed in the case of the three-wire system, the cost of conductors for the inside wiring would be 43 cents. In making the comparisons, however, we will give them the advantage due to the 75 feet distribution; that is, 24 cents per lamp.

I have plotted these results expressing cost as ordinates, and distances as abscissae. The curves resulting are here shown. [See diagram.]

In the diagram, curve number 1 shows cost of primary converter and secondary for alternating system (converters at $3 per lamp).

Number 2 shows cost of primary and converter for alternating system.

Number 3 shows cost of primary for alternating system.

Number 4 shows cost of feeders for average loss of 4 per cent.

Number 5 shows cost of feeders for average loss of 6 per cent.

Number 6 shows cost of feeders for average loss of 8 per cent.

Number 7 shows cost of feeders and mains for average loss of 9 per cent.

Number 8 shows cost of feeders and mains in the three-wire system for average loss of 6 per cent.

Number 9 shows cost of feeders and mains in the three-wire system for average loss of 8 per cent.

In the three-wire system curves for total cost are the lines in black just above the dotted lines.

It will be seen that if the three-wire system be operated at an average efficiency of 92 per cent. in the feeder, which corresponds to the highest efficiency claimed for the alternating current converter system, the total cost per lamp would be equal when the average length of feeder was 6,000 feet. An average length of feeder of 6,000 feet corresponds to circular area 18,000 feet in diameter; that is, about 3½ miles in diameter. In practice, it is preferable to operate at higher efficiency, making a large investment in copper, which has the strong recommendation of having the least depreciation, and requiring the least attention of anything used in connection with the transmission of energy.

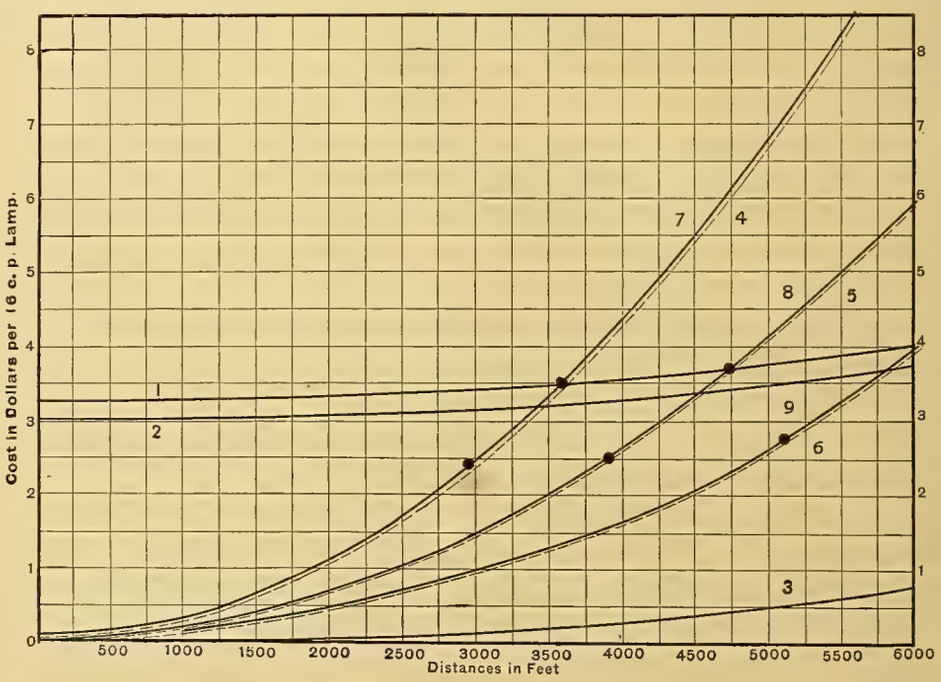
The middle curves represent an average efficiency of 94 per cent. in the feeder; that is, an average loss of 6 per cent. in the feeder. You will notice that even with this superior efficiency the three-wire system is cheaper per lamp than the alternating current converter system at an average length of feeder of 4,750 feet, corresponding to a circular area of 12,000 feet in diameter, and that for shorter distances the cost rapidly diminishes — the cost of conductors for three-wire system at this efficiency with an average length of feeder of 3,000 feet corresponding to circular area of 9,000 feet in diameter, being less than one-half the cost of conductors and converters for the alternating system.

Even with the very high efficiency of 96 per cent. in the feeder, or an average loss of but 4 per cent. the conductors of the three-wire system are cheaper than the conductors and converters of the alternating current converter system for an average length of feeder of 3,600 feet or less, and this corresponds to a circular area of 11,000 feet in diameter.

Suppose that both the generator and converter are so much cheaper than we have assumed as above that it makes a total reduction of one dollar per lamp. We then find that under conditions of equal efficiency, 82.9 per cent. the three-wire is cheaper where the average distance to lamps is one mile or less. With the usual efficiency for the three-wire system, 84.7 per cent., it is the cheaper for an average distance to lamps of 4,000 feet, or less, and with the highest efficiency, that is 86.5 per cent., with average loss of 4 per cent. in the feeders, the three-wire system would be the cheaper when the average distance to lamps is 3,000 feet or less.

Suppose, on the other hand, that the incandescent lamp be doubled in voltage, and increased 25 per cent. in economy; at the same time, that the cost of converter was reduced to two-thirds its present cost, and we find that with the highest efficiency, 96 per cent. in the feeders, the three-wire system would be the cheaper for cases where average distance to lamps is 8,000 feet or less, which corresponds to a circular district about five miles across.

Before leaving the question of economy of operation, let us look at the question of depreciation. In any dynamo the depreciation naturally becomes greater when it is operated at high e. m. f., even where the type is the same, and in the high e. m. f. alternating current generator there exists the greatest tendency toward troubles due to the breaking down of the insulation of the wire on the armature. The secondary circuit of the alternating current system and the inside wiring of the three-wire system would have a similar depreciation, but there is a great difference between the depreciation of copper conductors carrying low e. m. f. continuous currents and the depreciation of highly insulated conductors carrying a high e. m. f. alternating current together with the depreciation on an expensive piece of apparatus like the converter, the large proportion of the cost of which is represented by labor. Try to compare the value of copper 20 years hence which costs $1,000 to-day with $1,000 of converters, and small highly insulated wire such as is used in the primary circuit of the alternating system, and I think it will be evident that the depreciation of the alternating system is going to be many times that of the three-wire system.



Reliability.—In ordinary practice in the three-wire system every lamp is partially supplied by every feeder on that side of the system. That is, the current can flow out on any such feeder and through the network of mains and finally reach the individual lamp. Similarly, every lamp is supplied in part by every dynamo operating in multiple arc on that side of the system, so that the larger the system, the more reliable it becomes, and an accident to an individual main, feeder, dynamo belt or engine does not in any way affect the operation of the light, and in the worst event trouble in an individual building would only result in half the lamps on that circuit going out, and the other half would be scattered alternately among those which would go out, so that the result would not be even troublesome.

Now how about the alternating system? Thus far they have not found it practicable to operate their generators in multiple arc, and it is not likely that they will ever be able to in common practice. This means more than is generally appreciated. Every lamp burning on an alternating system depends upon the continuous operation in unison of six separate appliances, each of which is liable at any moment to cause an instantaneous extinction of the light in question. These six things are:

First. The individual secondary circuit which supplies the lamp.

Second. The individual converter which supplies the lamp.

Third. The individual primary circuit which supplies the lamp.

Fourth. The individual generator which supplies the lamp.

Fifth. The individual belt for the generator.

Sixth. The individual engine which supplies the power.

The next best thing to reliability is ability to reduce the time the light is out to a minimum, and to accomplish this it becomes necessary to install a spare system of conductors which are only brought into service when a primary circuit gets into trouble. An expensive switchboard in the central station also becomes necessary, so that in case of trouble to a generator its load can be thrown over to another generator with the least possible effect upon the lights that the generator has been supplying. The secondary circuits from one primary can be multiple arced and this is sometimes done, and this adds somewhat to the reliability of the light, but the expense due to this connecting of converters by heavy wires required by 50 volt lamps makes it impracticable in usual instances.

Unless the alternating current generators are operated in multiple arc, the reliability of the alternating system cannot be as good as that of an arc light system, and we all know how reliable that is.

Variety and value of the possible sources of revenue.—We now come to the consideration of the variety and value of the possible sources of revenue. The first and most important revenue for a central lighting station outside of the light itself, is power.

In a central station running night and day, the cost of generating additional power beyond that required for the light, is quite small—probably not exceeding $30 per horse power per year for ten hours per day. This amount of power distributed in small units as required in practice will readily sell for $100 per year. Owing to the fact that a large number of small motors, varying in their requirements as to power from moment to moment, are supplied from one common source, a certain production of horse power will supply the demands of motors representing a total maximum horse power some two and one-half times as much as is produced. In other words, for every horse power produced at $30, you can sell two and one-half at $100 each ; or, you can sell for $250 what it has cost you $30 to produce. It goes without saying that the ability to supply such demands is of the utmost importance to a central station. The continuous current system is well adapted to the supply of power for any and all purposes. No practical method of operating a motor by means of the alternating current has as yet been devised, and the problem presents great difficulties, principally on account of the necessity of a comparatively continuous current for charging the fields, and the instability of the torque of such a motor.

We are promised great results and extended use of the storage battery, and undoubtedly it will be used considerably for a great many purposes, therefore there is a large possible revenue from this source, which the alternating system will not be able to supply.

Then there is almost unlimited number of applications of a continuous current on a small scale for such purposes as fire alarms, burglar alarms, distribution of time, annunciators, tickers, electro-plating, telegraph lines and telephones, all of which rely upon a continuous current ; and there are innumerable applications which will soon develop consequent upon the absolute reliability and constancy of the electrical pressure at command. Out of the numberless applications of the electric current which we see daily, I can think of no commercial application except the production of light and heat, for which the alternating current under discussion is available, and the production of heat by the electric current does not present a flattering outlook as a source of revenue to the owners of central station plants. Therefore we see that to-day the alternating system is dependent for its revenue upon the sale of light alone, while the continuous current is applicable to almost every conceivable use to which the electric current is put.

Safety to Life.—The safety to life of the three-wire continuous current system using about 230 volts as a maximum e. m. f. is undoubtedly absolute. It is impossible for a consumer of such a system to injure himself by the shock in any conceivable way, and a slight burn in case he makes a short circuit in too close proximity to some portion of his person is the worst result possible, and this is almost an unheard of possibility. It has been conclusively proven in practice that the 1,000 volt alternating current is fatal to human life, and will kill a horse. Although perhaps not likely to occur, it is always possible for the primary and secondary to get into contact either in the converter itself, or possibly in circuits outside of it. Any person handling the wires of the secondary and a fairly good ground is then liable through a possible ground elsewhere to be instantaneously killed. The most dangerous thing is the one which is usually perfectly safe, and occasionally dangerous, as is witnessed by the death of a telephone operator at Pittsburgh recently; while he was as usual, handling various contacts about the switchboard, a high electromotive force circuit became closed somewhere outside with the telephone line, and without the slightest suspicion of any possible danger he was instantly killed in doing what he had done thousands of times before.

Effect Upon Existing Property.—The low e. m. f. of the ordinary three-wire system, the perfect protection from excessive current effected by the safety devices in use and the continuous character of its current, render it practically inert as far as its influence upon existing property is concerned. That the alternating system with its high e. m. f. and its strong inductive influence will occasionally cause serious trouble to existing telegraph, telephone and other lines, which it is adjacent to, seems inevitable.

From the foregoing comparisons, I consider the alternating current is not applicable to central station lighting, as it is at present operated, except as a possible occasional adjunct, or else upon an extremely small scale in cases where a few lights very greatly scattered are required, and where power is cheap. In cases where cheap power exists at a distance of several miles from a town capable of supporting a station of 2,000 lamps and upwards, high initial e. m. f. becomes both desirable and necessary, but the continuous current converter, which already exists in several forms, and which is receiving the attention of the best electricians and inventors of the world, will, in my opinion, be the device to supply this demand, and that very shortly.

At the close of the paper Vice-President Brown called for discussion.

MR. SPERRY : I think Mr. Leonard has made a very fair presentation of the subject and know that I voice the sentiments of those present in this respect. Such a vast amount of data has been presented that it is extremely difficult to take up the points in detail. I think the comparative efficiency lies in the economy of the 50 volt lamp over the 110 volt lamp in its bearing upon the data presented, but I believe the balance is in favor of the alternating system. In its application to the curves on chart 4 before us, of course the cost of the feeders represented by the dotted lines would increase four times, that is, increase as the square of the distance. Some of the advantages of the three-wire system might be claimed by the alternating current equally with the direct current.

While at Pittsburgh I noticed a three-wire converter by means of which 100 or 50 volts could be supplied ; that, I think, would answer some of the objections of the gentlemen to the want of continuity in the supply in case some of the service wires were rendered inoperative. I think the practical efficiency of the alternating current is shown by the increase in percentage in table number 3 where the distance is increased 600 per cent. and the total cost is increased only 25 per cent.; that would seem to indicate together with the direct line on chart 4 the entire independence from distance of the alternating current system. Of course, at the present time the large centers of demand for incandescent lighting, are being rapidly supplied and it seems to me that in the near future the great demand will be in the sparsely settled towns where the residents do not have the conveniences afforded by gas in cities, and where the demand for artificial illuminant is great. As has been stated the advantages lie with the alternating system in such cases. However, any person going into the station at Pittsburgh, where there are five 2,500 light machines in operation would not think the application of the alternating current was limited to a small number of lights. I think the practical application would be impressed on one's mind on the Daft system of electric railway across the Monongahela river from Pittsburgh. We must have been three or four miles from the source of supply for the lights on that side of the river when we were on that road and it was stated that quite frequently those lights are maintained from the central stations.

I am told that this matter of 50 volt lamps is quite important. Next to the cost of fuel, which by the way, I think is overestimated in the operation of a station, the expense of operating stations is the cost of lamps. Of course, when a lamp is broken it is entirely worthless, no matter whether its disability comes from having expired at the end of its life or whether it comes from fragility of filament or whether from carelessness on the part of the one handling it. It is a fact, however, that a 50 volt lamp has a very much more rigid filament. I was told in the station I have mentioned that the average life was away above 1,000 hours.

MR. LEONARD : I think it is possibly true that a 50 volt lamp can be made to give a longer life than a lamp of 110 volts, in other words that lamps of 50 volts may possibly be operated at a higher efficiency and give the same life ; nevertheless I do not know of any lamp in existence that is operated at less than three watts per candle and a very satisfactory life is attained at this efficiency. A life beyond 1,000 hours is not desirable on account of the fact that incandescent lamps necessarily deteriorate to a certain extent, and lamps that go to 2,000 hours instead of generating light at 3 watts per candle would operate at an efficiency nearer 4 or 5 or 6 watts per candle. Of course, it is possible to reduce the cost of conductors by operating at a much higher e. m. f. and converting from 2,000 or 3,000 volts to 100 volts, but the total cost is very little reduced by any such method. One or two of the most prominent systems have started out with 2,000 volts converted to 100 volts, but they have almost invariably changed to the 50 volt lamp. I am inclined to think that the 2,000 volts is impracticable to handle.

The practice is to put the converters for a large number of lamps as near the lamps as possible in order that they may have the conductors of as short a length as possible, thus reducing the cost. I am not inclined to think that any practical operation of the alternating current on a three-wire system has been obtained.

As to the continuity of supply Mr. Sperry has referred to the station at Pittsburgh. I made no mention in the paper of any particular system or any particular weakness, but one point that impressed me at Pittsburgh was that in addition to the five large dynamos in that station, behind the dynamos stood a spare armature which gave me the impression that it was put there for an emergency. While I was down there they started a new station of 5,200 lights and the first week they ran they burned out four armatures.

Relative to the independence of distance of the alternating system, it struck me as rather odd that at Pittsburgh—the very home of the alternating system—they should find it necessary to establish two systems. The cost of operation and maintenance of any system is certainly reduced if they can operate from one source of supply.

In regard to the operation of lamps at a great distance from the station, of course that is a very strong point, and yet I do not consider that the lamps as they existed in that station at those long distances were any more liable to be continuous than in the case of a series system, which of course can be operated at the same distance and probably with equally good results.

In these curves I have not attempted to confine the comparison to the case of equal efficiency although in according the alternating generator an average efficiency of 90 per cent., we have given them a considerable allowance and as regards the average efficiency of the converter at 95 per cent. that is very much in excess of any test that has been made.

The Zipernowski-Deri company have a very good converter and had it tested by an eminent electrician. It showed an efficiency of 92 per cent. under full load, which of course represents the best condition as regards economy of operation. But the electrician of the manufacturing company acknowledged that the converter that had been given for test was one that had been specially made, that the iron had been so finely divided and the expense so much increased thereby, that it would not be economical to make it for commercial purposes.

Relative to the efficiency of the converter itself I was impressed quite recently by reading a patent taken out by Rankin Kennedy of England—perhaps the best posted man on converters in existence. The patent reads : "The rapid reversals of the current in transformers causes a great deal of loss by heat in the magnetic iron. This is overcome by winding the core with a wire carrying a continuous circuit which maintains the magnetism of the iron in one direction, the effect of the usual primary and secondary being to increase or decrease the magnetism without changing its direction."

It strikes me that if a man of Mr. Kennedy's ability should find it of value to take out a patent—upon the running of an entirely separate system of wires carrying a continuous current to maintain the magnetism in one direction and thereby increase the cost of the converters by this separate winding, the only conclusion we can draw is that there must be considerable loss in the converters as at present constructed, to warrant such an expense in order to save a portion of this loss.

Relative to safety, I quote from Mr. Kapp another eminent authority. In a discussion before the society of Telegraph Engineers and Electricians he said : "To bring high tension wires over and across our streets, allow high tension branch leads to pass into our houses and give every subscriber a little transformer system of his own seems to me to be positively courting disaster." His idea seems to be that converters should be placed outside of buildings and not brought into buildings. If they were placed outside always the average distance to lamps would be twice as great as we have assumed and the cost four times as much.

We granted 90 per cent. efficiency for the generator which is very high. We also granted an average efficiency of the converter of 95 per cent. In practice these converters are operated at 40 per cent. of the maximum load and granting them 95 per cent. efficiency with an average load of 40 per cent. is giving them a very great advantage.

I do not think that there are many instances where it would be desirable to operate as far as 9,000 feet from one central station. Once in a while a case of this character is found. Where there is a water power a converter system of course can be applied at a not greatly increased cost but that converter system would not be as reliable, as we have seen, and would not be as well adapted to meet the demands which would arise.

The continuous current converter is something that is going to fill that place in lighting. One form consists of a dynamo wound for 125 volts and 400 amperes with another separate winding of 1,200 vo'ts and 40 amperes. At the further end—at the water power—are placed continuous current generators of 1,000 or 1,200 volts. Two of these generators are placed on a three-wire system. Their current of 40 amperes makes the cost of copper one-third what it would be with the 1,000 volts converter system. The conductors are led into the town and led into the upper story of some building where the converter and switch board are placed. On this motor generator on the same armature and in the same field is another winding which corresponds to 40 amperes and 1 000 volts. The continuous current is delivered to the brushes on the commutator for 1,000 volts and the field is charged by the thousand-volt current. As soon as the current is applied in this armature, the field being charged, it revolves as a motor and in going forward as a motor, the second winding is carried with it cutting the lines of force and generating 125 volts and 400 amperes. This piece of apparatus has no belt and can be operated at very high speed. Perhaps the prettiest point in this converter is this: The current in the high potential winding is in the reverse direction of the current in the low potential winding. The magnetizing effect of the high potential circuit can be made to exactly counter balance that of the low potential winding. There is absolutely no spark.

The converter has been made and is all ready to place on the market; but it has been learned that the cost per lamp can be very much reduced, by increasing the speed of the armature; the generator has thus far been applied to the Siemens armature but on account of this a form more nearly like the Gramme ring is being tried. It is stated that it is possible to manufacture this motor generator at a small fraction of the cost per lamp of the ordinary continuous current generator. In this generator Foucault currents there are almost entirely absent.

Two of these motor-generators can be placed in series on the three-wire system and a number of them in multiple arc on each side of the system. The regular three-wire system of supply can be used and power and everything of that nature can be supplied from this central station. Of course, this high rotative speed is of no consequence provided the bearings can be kept cool. If a belt were used, of course, there would be a limit to the speed.

When it comes to having a central station in the center of a town and it becomes desirable to operate lights in an occasional residence located at a distance of two or three miles and where the lights are scattered, there certainly seems to be an advantage on the side of the converter system, but of course this is merely an adjunct to the more profitable station in the center of the town.

MR. SPERRY: I seem to be the only advocate of the alternating current system. I may say that I saw the first converter and the first alternating current generator quite recently, and when I first saw them I was a sceptic on the subject; I did not believe in it; I shared the opinion of our esteemed brother Mr. Haskins, as to the tremendous danger of it, but when we were shown the station at Pittsburgh where every courtesy was extended, I changed my views.

Inasmuch as the motor generator has been brought forward and inasmuch as it is understood that I am not an advocate of either system, it may be wise for us for the moment to consider the construction of the alternating current generator, where this 5 per cent. in the converter goes, and where the 10 per cent in the generator goes. The armature of the 2,500 light machine in Pittsburgh was 25 inches in diameter. The armature consists of thin plates of iron insulated from each other. This insulation determines, of course, the Foucault currents to a large extent; upon the surface of this iron, mica is placed and a single layer of number 10 copper wire, cotton covered, is wound around only forty pounds of wire! The internal resistance therefore can not be very much. If this armature as a part of the apparatus is very wasteful, that force must manifest itself in some way. Therefore if this this machine is very wasteful, a large amount of heat must show it-elf somewhere. Disregarding the manifestation of the field of force, calling it perhaps 7 or 5 per cent., it leaves a percentage of from 3 to 5 per cent of a total amount of energy dissipated by that machine in developing heat in the Foucault currents in the armature. This of course, will produce a large amount of heat and this heat must be taken away; we would have an immense amount of heat coming from the machine but the heat is not in any sense as large as might be expected from the large amount of energy that we have been told has been wasted in that machine, It is very small as compared with the heat of Foucault currents.

In the laboratory of the Westinghouse company there were a number of converters that had been in operation for some time. I asked permission to place my hand upon them. I noticed they were not very warm. Of course, that being the fact there could not be a great loss of energy.

By means of the alternating current system, lights used in theaters can be reduced in candle power without putting in a resistance. They have a self-induction coil by means of which the actual development of current is stopped. That is a point that has not been brought forward.

It is my opinion that 95 per cent. as the efficiency of the converter and 90 per cent. as the efficiency of the generator including the efficiency of the exciter is by no means high.

MR. LEONARD: The alternating current system presents a very pretty feature regarding its use in theaters but in point of economy thereby attained I think the value of that is trifling; in the ordinary method with continuous currents the energy absorbed under most conditions when lamps are very dim—is only one-half of what it would be if they were burned at full candle power. Of course they are burned down only a part of the time and the effect upon the economy of a central station is imperceptible.

In regard to the heating of the converter of course 2 or 3 or 4 or 5 per cent. even of energy in that mass of metal—and there is a very large mass of metal in pounds per watt of energy used can be very readily dissipated and I think that the weight of metal is very much greater in a converter than in an ordinary generator.

In the generator, notwithstanding the tremendous surface velocity of the armature, the great area exposed and the very perfect ventilation afforded by the form of construction, the blast of air from the machine is very hot and indicates that the energy due to Foucault currents etc. is much greater than in the case of the ordinary Siemens armature which is much cooler notwithstanding its comparatively slow surface speed, small radiating surface and the fact that it has no means of ventilation except from the surface.

MR. ANDREWS: Mr. Leonard deserves credit for his able and fair presentation of this matter. There is one point that has not yet been brought out with regard to the alternating current dynamo and that is its perfect self regulation I have seen 75 per cent. of the load turned off from an alternating current dynamo and the lamps hardly raise to any perceptible e. m. f. I think that is an important point.

There is another point with regard to the depreciation of underground conductors. I can only guess at it—but I think that with the direct current in underground conductors and perhaps in overhead conductors faults are very often developed by electrolysis. I do not think that with an alternating current electrolysis could possibly occur. However, it is simply guess-work with me.

I have a letter here from a gentlemen in Denver, connected with an alternating current plant, which bears upon this discussion. You will note that the writer is a man of very strong convictions. I cannot personally substantiate his statements but I know him to be a truthful man and know that his statements are made in good faith. For its bearing upon the discussion I read it.

"We have not had a hitch of any kind at the station since starting. The dynamos have been run at full load, and sometimes at overload. We have run the two number 1 dynamos in multiple repeatedly, each with full load and each taking the same number of amperes with both large and small loads. We have several times run two number 2 dynamos in multiple, and on two occasions have run a number 1 and number 2 in multiple, and always with most satisfactory results. I think I can truthfully say that it is even easier to run alternate current machines in multiple than continuous current machines. We can detect no loss from retardation in the underground feeders, though the loss in all cases is under 2 per cent., and any additional loss would be readily noticed. Our shortest underground feeder is 3,090 feet and the longest 8,000 feet, and the conductors are only separated by about one-eighth of an inch. Two of the underground feeders have the full load for which they were designed. We are not troubled in the least by induction on telephone circuits—they run parallel with our wires in several places—and in a recent interview with the telephone manager, he informed me that he has noticed no increased induction on his wires since we started.

"The only trouble of any kind we have had—except some short circuits—has been with our underground work, and really did not amount to much.

"The cable [Standard Underground Cable Co.] itself has not given us the least trouble, but with the connections in the manholes, as they were made at first several grounds and crosses were made. These connections are now being made continuous with wiped joint lead sleeves, and we anticipate no further trouble from them. We had one ground in a lead joint, the first joint made here. We have had several short circuits, caused by the old arc light linemen trying to put "jumpers" on our wires and from other accidents while the men were working on the lines. The dynamos stood them nobly, though some of them held on for quite a while, one of them even stopping the engine. We have not had the least kind of an accident with any of the converters. Several of the men have received a shock from the 1,000 volts alternating current, and are none the worse off from it. I have received it twice myself. We have kept some of the machines running for a week without shutting down.

"Our distribution has panned out splendidly, not half a volt difference in pressure any where in town"

MR. LEONARD: That alternating current machines can be operated in multiple arc is a well known fact, but that they can be operated in multiple arc with economy is a very different matter. I think there is scarcely a plant that has more than one alternating current dynamo that has not been run in multiple arc, but I think that in every one of them the machines are at present being operated independently. When these dynamos are multiple arced they occasionally make a perfect division of the load, but suddenly one dynamo will shift the load, and the other will not only take it, but drag the first dynamo. Reversals of current must accord with each other perfectly. If they do not, it means that the current of one generator is acting against the other.

Electrolysis is an important matter, and should be given due weight.

I noticed that at Denver the longest feeder is 8,000 feet. I know of an instance in an Edison station where there is a feeder of over 6,000 feet, and I would not hesitate, under proper conditions, to operate it at 8,000. Probably the average length of the feeder in the Denver station is not over 6,000 feet, and in this case [indicating on diagram] the cost for copper wire is identical with that of conductors and converters of alternating system. At 3,000 feet, which I consider much the more common practice, the cost is in favor of the continuous current, being less than half that of conductor and converter. The one point which I wish to emphasize is reliability and depreciation, in which I think the alternating current system is much inferior to the continuous.

The statement was made in the letter that one of the generators had been operated continuously for quite a long time. It was not stated that the generator had been operated at full load. That matter was not touched upon.

MR. SPERRY: There is another point about the alternating current dynamo. It is a complete demagnetizer. I mention this for the benefit of Mr. Giles. [Laughter] The practical outcome of that is that it does not blacken nicely frescoed ceilings where the wires run,

MR. LEONARD: When we run inside wires over nicely frescoed ceilings, we run them above the ceilings concealed from view.

MR BLISS: I think it is assumed that the cost of the generators is the same, for both the direct and alternating current. I would like to ask if this is so?

MR. LEONARD: Certainly. By looking at the alternating current generator of 2,500 light capacity, an ordinary observer would think the cost per lamp must be less. While I assumed in the paper that the total cost was the same, I stated that any possible difference would not cut any appreciable figure on the total cost. If they can supply an alternating current generator cheaper than a continuous current generator, it certainly strikes me that they have a great field for isolated lighting. The self-regulation, if it is superior to the continuous current generator, as has been claimed, together with the entire absence of a commutator, which is certainly desirable, would give it a tremendous advantage if it could be sold much cheaper than the continuous current dynamo. As such dynamos are not being introduced, it would lead one to suppose that the profit due to the sale of them was not sufficient to warrant their construction in competition with the continuous current dynamo.

A Fort Wayne Indignation Meeting.

A press dispatch dated the 2nd, from Fort Wayne, Ind., says. "An indignation meeting was was held at the Business men's exchange here this evening to protest against the action of the city council in advertising for bids for lighting the city with electricity after having conferred with the Jenney electric light company and received a reasonable proposition. The Jenney company is a home institution, and has a large plant here. Feeling that they are not appreciated they have withdrawn their proposition, and are considering propositions from Peoria, Kansas City, and Marion, Ind., with a view to moving their plant to one of the cities named. They have received some flattering offers, and the citizens of Fort Wayne realize the importance of doing something to keep the plant here. The meeting was largely attended, and action was taken asking the council to reconsider their action, which will probably be done, as the entire business representation of the city demands it."

CORRESPONDENCE.

From Kansas City.

KANSAS CITY, March 3. — The Landis hotel recently thrown open to the public is second to no house in the west in point of electrical equipment, which consists of two Edison dynamos of 300 lights capacity each, which furnish light for 100 rooms. The court of the hotel is laid out with large flower beds. At each corner is placed an iron tower twenty-five feet high, on each of which will be located twenty-five 32 candle power lights. There are now 700 lights used in the structure. The installation of the plant was under the supervision of M. E. Bates, of the Western Electric Construction company, and the annunciator work and the fire alarm work was under the supervision of W. H. Wooding, of the Kansas City Electrical works. A 90 horse power Ide engine furnishes power for the dynamos.

The Postal Telegraph company has to-day purchased the Pacific Mutual Telegraph company's entire business; consideration, $150,000.

The Inter-State Electric Company, of this city, has been granted a franchise to place poles and run wires in the city for incandescent lighting from storage batteries.

The Thomson-Houston system is used in the Warder Grand Opera House and hotel and at the present time 1,500 lights are in the circuit. The engine room is fitted with the most approved appliances and contains a 125 horse power Armington & Sims engine which furnishes power for the dynamos. The wiring from the dynamos is concealed under the floor. The switchboard contains two main switches, eight feeder switches, two ammeters, pressure indicator, ground detector, etc. The system is fed through four feeders running from the main "bus" in the dynamo room to take the center of distribution at the following points: One at the theater switchboard, 825 lights; one at the ticket office, 165 lights; one at main vertical in hotel, 395 lights; one in remote part of hotel, 115 lights. The theater switchboard controls lights within

the theater proper. The cut-outs, wires, etc., are concealed from view behind the switchboard. Switches, regulators, dials, and pilot lamps are located conveniently for manipulation. The circuits are controlled by thirty switches, nickel plated with name plates to correspond, also by nine regulators located in the basement and operated by dial with hand wheel upon the switchboard. Every circuit is controlled by regulator provided with pilot lamps showing candle power of the circuits at all times. The regulators control as follows: One for each five borders, one for foot-lights, one for bunch of ground rows, one for the house total or in portion, and one for the stage. The lights in the theater are arranged as follows: On 5 borders, 225 lights; foot-lights, 75; proscenium arch, 60; house, 350; miscellaneous bunches, ground rows, dressing-rooms, stairways, etc., 115. About 200 of the house lights are behind stained glass, giving a soft and beautiful effect. The switch in the ticket office controls all lights connected with the theater vestibule, lobby, corridors, pavilion, parlor, smoking rooms, etc., there being a switch for each line of brackets on each electrolier upon different floors. The installation was made under the supervision of M. E. Bates, the general superintendent of the Western Electrical construction company. D.

Omaha Notes.

OMAHA, MARCH 3. — The most interesting electrical event which has taken place recently is the sale of the Pacific Mutual Telegraph company's lines, to the Postal Telegraph company, which in turn has transferred the property to the Western Union Telegraph company. This purchase again places the Western Union in control of all telegraph business in this part of the country. There is no indication of an increase in rates. Whether the projected lines of the Pacific Mutual to points west will now be constructed, is not known, but it is quite improbable, as the lines of the Western Union already cover the territory.

A severe sleet storm, on the 1st ult., broke down a majority of the telegraph lines in this vicinity, and business for a day or two was almost suspended. The extra territorial lines of of the Nebraska Telephone company also suffered severely.

Last November the Nebraska Telephone company was granted a temporary injunction, restraining the York (Neb.) Electric Light & Power company from constructing and operating its lines on the same side of streets and alleys occupied or to be occupied by the lines of the telephone company. A decision has just been rendered, which leaves the matter still doubtful. The Electric Light company is given permission to operate its incandescent lines on the same side of streets and alleys, and within eight feet of the telephone lines, but the operation of arc or power lines on the same side of any street or alley occupied by telephone lines, is forbidden. The north side of the public square was the principal point of contest, and the telephone company proved priority of right by having poles distributed there three days in advance of the electric light company and had its lines up several hours before the electric light lines.

The Electric Light & Power company is organized to use the Mather system and a large number of the citizens are pecuniarily interested in the success of the company, and friends of the telephone interests are not lacking. The case has been appealed by the telephone company but a supreme court decison will not be reached before six months or a year and in the meantime the electric light company will be restrained by the temporary injunction from carrying on its business. A compromise of some sort is probable.

A. F. Cutler, secretary and treasurer of the Iowa Union Telephone Co. was in the city last week, and seems hopeful of the defeat of the telephone bill introduced in the Iowa Legislature reducing telephone rentals to $2.50 per month and toll line service to 15 cents without regard to distance.

The Edison company will shortly install an incandescent plant in the *Herald* building in this city.

The Nebraska Telephone company in Omaha increased its number of subscribers by 64 in January and 75 in February. The publishers who formerly printed the telephone directory lost the contract this year. They published, however, a directory of their own. It was circulated in Omaha only. They have just issued another edition, and were to distribute it at once. The telephone company enjoined them from doing so, claiming it illegal and an unreliable publication. The hearing comes up April 2d.

The Midland Electric company has re-elected the officers of last year, and the annual report was quite satisfactory.

The American District Telegraph company of this city will shortly introduce the Field-Firman 11 call boxes.

Thos. Officer, president of the Electric Light and Power company, Council Bluffs, expects to add incandescent lamps at once to his system.

Tekamah, Neb., is agitating the question of telephone connection with Omaha and Sioux City, and of procuring an electric light plant.

W.

From Salt Lake City.

SALT LAKE CITY, Utah, March 3.—At the annual meeting of the stockholders of the Rocky Mountain Bell Telephone company, on February 27th, the following officers were elected: Geo. M. Scott, president; J. J. Dickey, vice-president; Chas. Sidney Smith, secretary; Geo. Y. Wallace treasurer; C. F. Annett, general manager. The foregoing with C. W. Lyman, H. C. Hill, George Albree and Thomas Sherwin form the board of directors. C.

THE ELECTRIC LIGHT.

It is reported that no theater will be allowed to open its doors in Madrid, Spain, next season unless the building is lighted by electricity.

An electric light company has been organized at Laredo, Texas, with a capital of $50,000.

An action has been instituted against the Progress Electric Light company of Mobile, Ala., by Mrs. M. A. English, whose residence adjoins the company's works. She asks for an injunction restraining the company from continuing in business at its present location as the machinery, she alleges, causes her house to vibrate continually.

Defective insulation of wires causes an incipient blaze at Epstean's Museum, Chicago, a week ago last Thursday. A Division street plank sidewalk was set on fire in the same way. The damage in each case was trifling.

The city council of Atlanta, Ga., has voted to contract for 100 arc lights for street lighting.

The city council of Adrian, Mich., has contracted for the lighting of the city by electric light for three years. Sixty arc lights are to be supplied and the charges are to be fixed as follows: First year, $5,800; second year, $6,200; third year, $6,000.

The Peninsula Electric Light & Power company with headquarters at Houghton, Mich., are now running about one hundred Thomson-Houston lights. The population of Houghton is only about 6,000, but within the territory accessible by the company—Hancock and other smaller places—there is a population in the neighborhood of 8,000 or 9,000.

THE ELECTRIC MOTOR.

The Chicago Arc Light and Power Co. is putting in a number of small motors from one-quarter horse power to two horse power. The city authorities now permitting the use of motors if distinct circuits and not the arc wires are used, it is expected that motors will rapidly grow in favor.

An invention of considerable importance to locomotive engineers is a contrivance to prevent collisions, which by electrical action automatically shuts off the steam in engines approaching each other on the same track.

Mr. Dunham, of New York has been granted a franchise to operate an electric street railroad in Ironton, O., and it is said he intends also to compete with the gas company for lighting the streets.

The Julien accumulator, says the London *Electrical Engineer*, appears to be giving very satisfactory results on the Brussels tramway. The total weight of each car, with its accumulators and its full complement of passengers, is 6,100 kilos; the weight of the batteries is 1,500 kilos; and the run, without changing the accumulators, is 48 kilometers, which, according to the report of the Congress of Tramway companies, might be increased to 55 kilometers. Two sets of accumulators are employed for each car, one being re-charged while the other is in use.

THE TELEPHONE.

More than 90 per cent. of the subscribers of the Cincinnati Telephone Exchange have signed a remonstrance against a passage of a bill fixing telephone charges at $3 per month.

The supreme court of Louisiana has recently decided that the New Orleans city council had no authority to adopt a resolution imposing a charge of $5 per pole on poles of a telephone company as "a consideration for the privilege."

The Bell Telephone company is continuing to have trouble with its unfinished conduit in Buffalo. A few days ago a series of explosions occurred on Washington street and five manhole covers were blown into the air. The cause of the explosion was the usual one, the accumulation of gas in the conduit. Two persons were severely burned.

Some time ago the Chicago city council ordered that no new permits should be issued for stringing telephone wires in the business district, but that all wires should be laid underground. County Treasurer Davis wanted a telephone for his office and a representative from the county board called at the telephone office to have the instrument put in. The manager of the telephone company, seeing a good opportunity to score a point, reported that they would have to string the wires over the house-tops, as they didn't have room in the conduits. Application was at once made to Commissioner Swift. He stated, however, that the application could not be granted and that if they could not get a wire to Col. Davis underground he would have to do without a telephone.

THE TELEGRAPH.

The house of representatives committee on military affairs has agreed to a favorable report on the bill which grants an honorable discharge to telegraph operators who served in the rebellion. The bill provides that no further compensation shall be granted the operators and that they shall not receive pensions.

The annual report of the Telegraphers' Mutual Benefit association shows that the organization has a membership of nearly 4,000. Since its formation the association has paid out over $300,000 to families of deceased members. The reserve fund now aggregates $70,000.

Frank J. Primrose, a wool merchant of Philadelphia, has sued the Western Union telegraph company to obtain $10,000 for the alleged incorrect sending of a cipher telegram.

John J. Flanagan, a war telegrapher, died in Utica, N. Y. last week. He was widely known throughout New York state as city editor of the Utica *Observer*.

Personal Paragraphs.

Prof. Thomas Gray of the University of Glasgow, Scotland, who is well known in this country for contributions to science in electricity has been appointed to the chair of dynamic engineering in the Rose Polytechnic institute at Terre Haute, Ind. He has accepted the position.

Business Mention.

The United States circuit court for the eastern district of Michigan has refused a motion for a preliminary injunction made by the Cylinder Oil Cup company against the Detroit Lubricator company.

Harvey & Lyle, photographers at 271 Wabash avenue, Chicago, have ordered a 7 light arc dynamo of the Excelsior Electric Light company through F. W. Horne, western manager.

The Central Electric company of 38-40 La Salle street, Chicago, have secured the western agency for the Butler Hard Rubber company of New York and will keep in stock a full line of rubber tube and rod and sheet rubber.

The Solar Carbon & Manufacturing company of Pittsburgh, Pa. in rebuilding their works destroyed recently by fire have put up strictly fireproof structures. They also took occasion to introduce improved machinery and at the same time increase their capacity. Their process of making electric light carbons from natural gas is strictly their own and is well covered by patents. C. B. Curtis is their Chicago representative.

Electrical Patents.

Issued Feb. 28, 1888.

378,426. Automatic Electric Photographing Apparatus. Edward N. Bliss and James F. Middleton, Newark, N. J.

378,432. System of Electrical Distribution. Thomas P. Conant, Brooklyn, N. Y., and Zach Latshaw, McKeesport, Pa.

The invention relates to an arrangement of apparatus for adapting a dynamo machine to supply a working circuit containing translating devices with current of an electromotive force and intensity, differing in those respects from that which the dynamo is constructed to furnish, combined with an arrangement of circuits calculated to economize the amount of copper or conducting material required to carry the current.

The first claim is given: "The combination of a secondary battery, a working circuit consisting of three conductors, and means for adjustably connecting two or more of said conductors to different points in said battery, whereby the difference of potential between any two conductors may be regulated."

378,436. Printing Telegraphy. Patrick B. Delany, New York, N. Y.

The general object of the invention is to provide a simple efficient system by means of which any of the operators at the several instruments on the line may communicate with each other or with all the others, as may be desired.

378,437. Printing Telegraph. Patrick B. Delany, New York, N. Y.

378,440. Electric Railway Station Indicator. George Guntz, Wilkesbarre, Pa.

378,456. Self-Exciting Alternate Current Electric Generator. Otto A Moses, New York, N. Y.

The invention consists in deriving alternate impulses from the armature, transmitting a portion of each impulse of a given polarity through a set of magnetizing coils applied to the field magnets and connected in a shunt upon the main line, while the balance is transmitted direct to the main line, and in transmitting the impulses of opposite polarity through a divided circuit, one division leading direct to the main line, the other through a second set of magnetizing coils operating to assist the magnetizing effects of the first set.

378,464. Telegraph Repeater. Louis Russell, Cherokee, Kan.

378,484. Battery Vessel. John Wiest, York, Pa.

The invention is designed to make the containing vessels strong, tough and durable.

The fifth claim reads: "A battery tank or vessel of fibrous material, impregnated with silicate of soda, coated inside and outside with a compound of silicate of soda and lime, having the inside lined with glass secured thereto, and the faces and joints of the glass lining coated with an acid proof material"

378,517. Rail Connection for Electric Railways. Edward L. Orcutt, Somerville, Mass.

378,527. Automatic Switch for Secondary Batteries. John S. Sellon, Hatton Gardens, County of Middlesex, England.

The invention is designed to prevent injury to the charging dynamo by return from the secondary batteries should the dynamo fail or fall too low to be effective. It consists of a polarized electro-magnet located in the main circuit operating an electro-magnetic switch which breaks the charging circuit whenever the direction of the current is changed from its normal polarity. The device includes an alarm for calling attention to any change from normal conditions in the current.

378,547. Regulator for Electric Generators. Warren S. Hill, Boston, Mass.

The first claim follows: "The combination, with an electric generator, or a mechanism driven by the armature thereof, and another mechanism driven by a motor included in the circuit of the machine, and connections between said mechanisms and the brushes, whereby the position of the brushes may be regulated in accordance with the relations of the speed of said mechanisms."

378,552. Relay Magnet. Edward L. Orcutt, Somerville, Mass.

378,560. Test Box for Underground Electric Wires or Cables. Richard S. Waring, Pittsburg, Pa.

Claim 1 reads: "In a testing box for underground electric wires or cables, a hollow post or standard having an enlarged head and located at or near the curb of the street, projecting above the general level of such street, a switch-board supported by such post or structure, a shell surrounding said post, and a hemispherical cover therefor."

378,561. Conduit for Electric Wires or Cables. Richard S. Waring, Pittsburg, Pa.

The first claim is given: "A conduit for electric wires or cables, having in combination an open-sided box and a removable cover therefor, said cover being composed of two or more parts, and being so constructed as to be sprung in place on the box and held therein by the resilient pressure of the sides of said box."

378,616. Arc Light. Lawrence N. P. Poland, Cincinnati, Ohio.

378,629. Secondary Battery. Max Stecher, Philadelphia, Pa.

The object of the invention is to obtain as great an active surface as possible in a comparatively small space and to secure the adhesion of the lead oxide to the lead plates.

Claim 1 reads: "A secondary battery formed of a series of porous cells, one within the other, circular lead plates or rings between the walls of the several cells, and oxide of lead packed in between the sides of the lead plates and the sides of the porous cells."

378,657. Automatic Electric Air Brake. J. Fairfield Carpenter, Berlin, Germany.

378,658. Valve for Electro-Pneumatic Railroad Brakes. J. Fairfield Carpenter, Berlin, Germany.

378,668. Electrical Stop Motion for Steam Engines. Robert Exley, Philadelphia, Pa.

378,677. Electric Gas Lighting Apparatus. Charles W. Holtzer, Brookline, Mass.

378,679. Lock Out Box and Shunt Circuit for Telephone Exchanges. Charles H. Haskins, Milwaukee, Wis.

378,681. Apparatus for Bleaching by Electrolysis. Eugene Hermite and Charles F. Cooper, Pownall Road, Dalston, County of Middlesex, England.

378,737. System of Electric Distribution. Thos. Spencer, Westbrook, Conn.

378,738. System of Electric Distribution. Thos. Spencer, Westbrook, Conn.

378,780. Telephone. Leo Ehrlich, Benjamin Dubinski and Gustavus Rein, St. Louis, Mo.

378,801. Underground Conduit for Electrical Conductors. M. Richards Muckle, jr., Philadelphia, Pa.

378,802. Manhole Chamber for Underground Electrical Conduits. M. Richards Muckle, jr., Philadelphia, Pa.

378,818. Double Arc Lamp. Merle J. Wightman and Einar Rasmussen, Hartford, Conn.

The feed is accomplished by mechanical means.

We give claim 3: "In a double arc lamp, a pivoted frame carrying a train of gearing for regulating the feed of the lamp, two carbon-holders supported thereby, a locking device, also mounted on said pivoted frame, for holding one of said carbon holders out of operation, and a trip for throwing said locking device out of engagement with said holder and putting it in operation as said pivoted frame becomes abnormally tilted."

Electric Light Carbons.

RICHMOND CARBON COMPANY,

NORTH ADAMS, MASS.

GEORGE P. BARTON,

LAW OFFICE,

Rooms 68 and 69 Temple Court, 225 Dearborn St., CHICAGO.

PATENT AND TRADE-MARK CASES.

The Parker-Russell Mining and Mfg. Co.

Electric Light Carbons

SUNLIGHT CARBONS

Adapted to all Systems.

CITY OFFICE,

711 Pine St.

ST. LOUIS, MO.

NEW ZEALAND.

WELLINGTON CITY COUNCIL.

TO ELECTRICIANS AND OTHERS:

The Council of the City of Wellington, New Zealand, invite tenders for the Lighting, by Electricity, of the streets and public places of the city.

Tenders are to be received by the 1st May, 1888.

The corporation having a full and ample water supply from two distinct sources, will supply the contractor, free of charge, with water for two high pressure turbines, each of 30-horse power actual.

The specification contains certain provisions relative to the supply of electricity for lighting and for motive power to private individuals.

Full specifications and conditions, plans and photographs of the city, and other documents and written information can be seen at the office of C. R. Buckland, Esq., resident agent for New Zealand, 327 Market Street, San Francisco.

The Council does not bind itself to accept any tender.

THOS. F. MARTIN,

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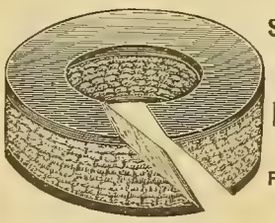

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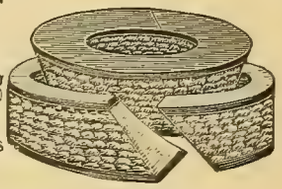

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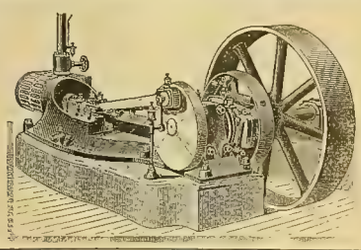

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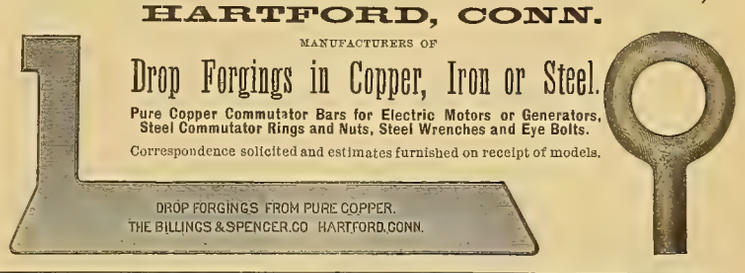

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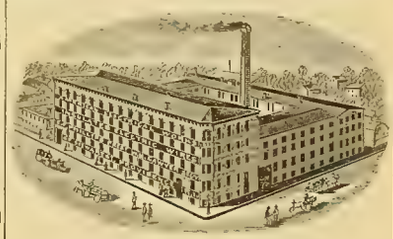

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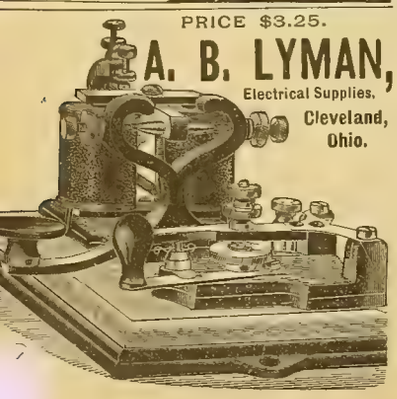

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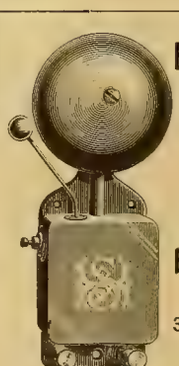

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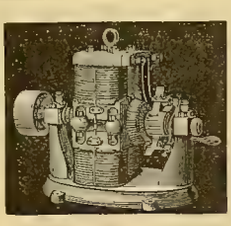

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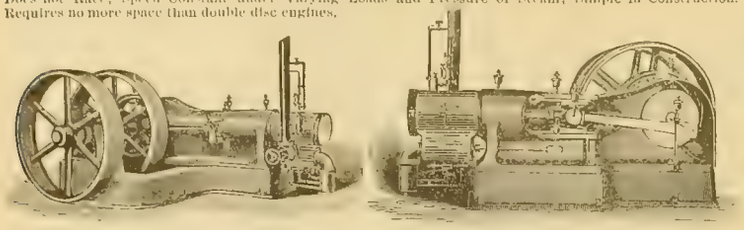

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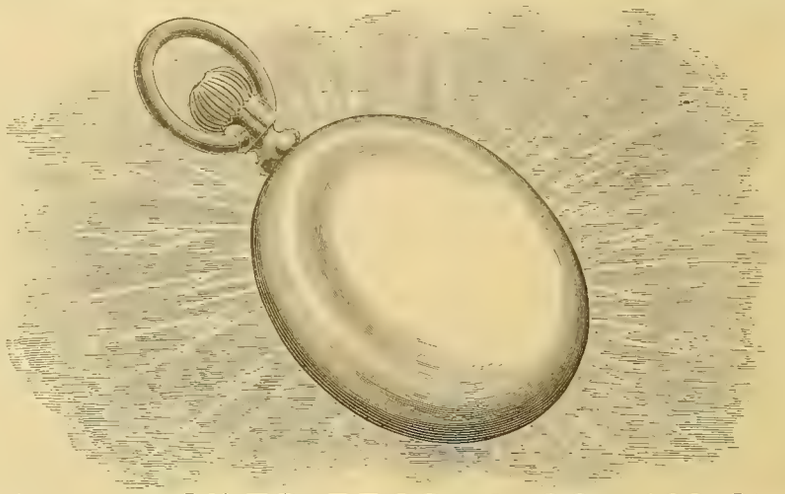

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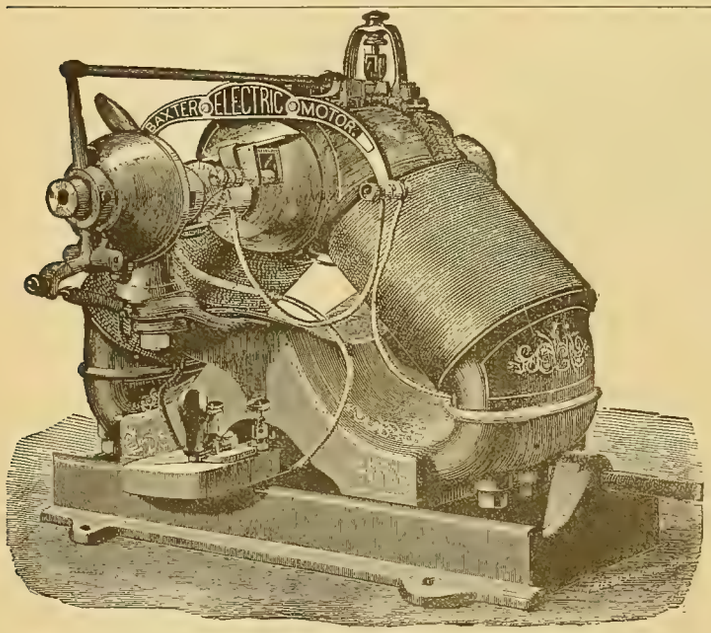

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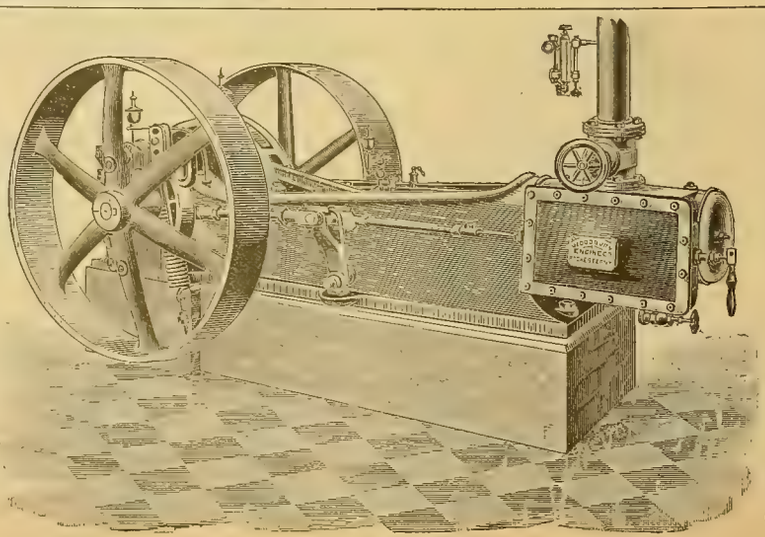

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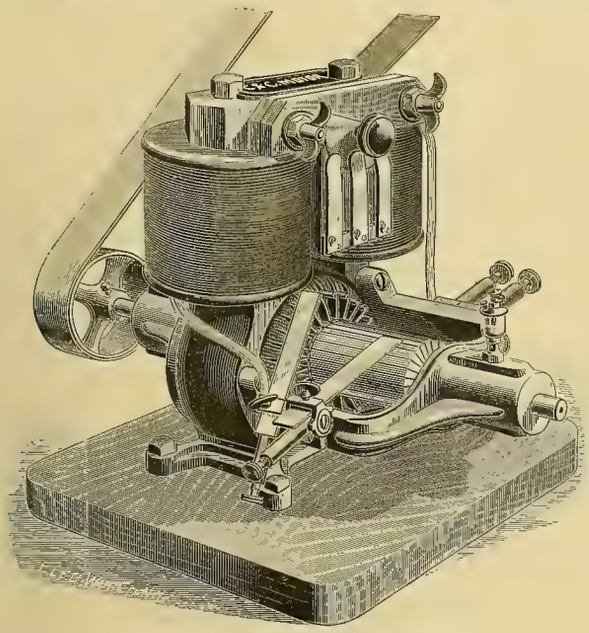

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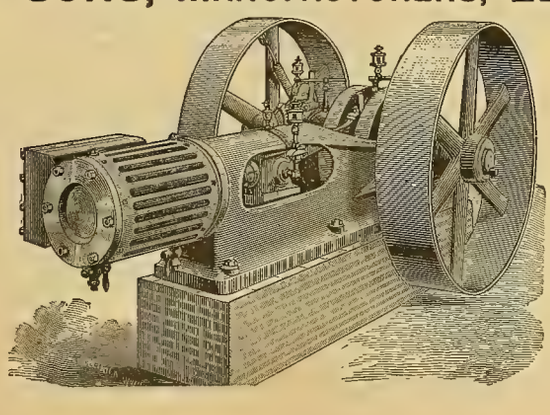

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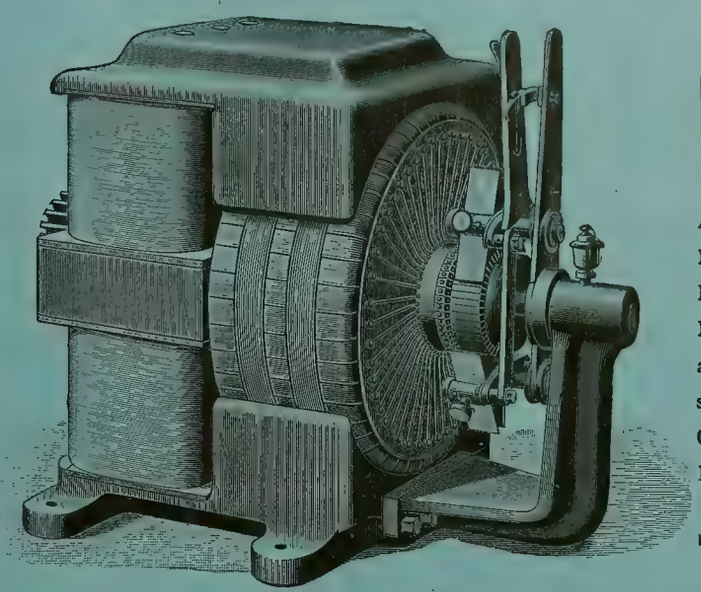

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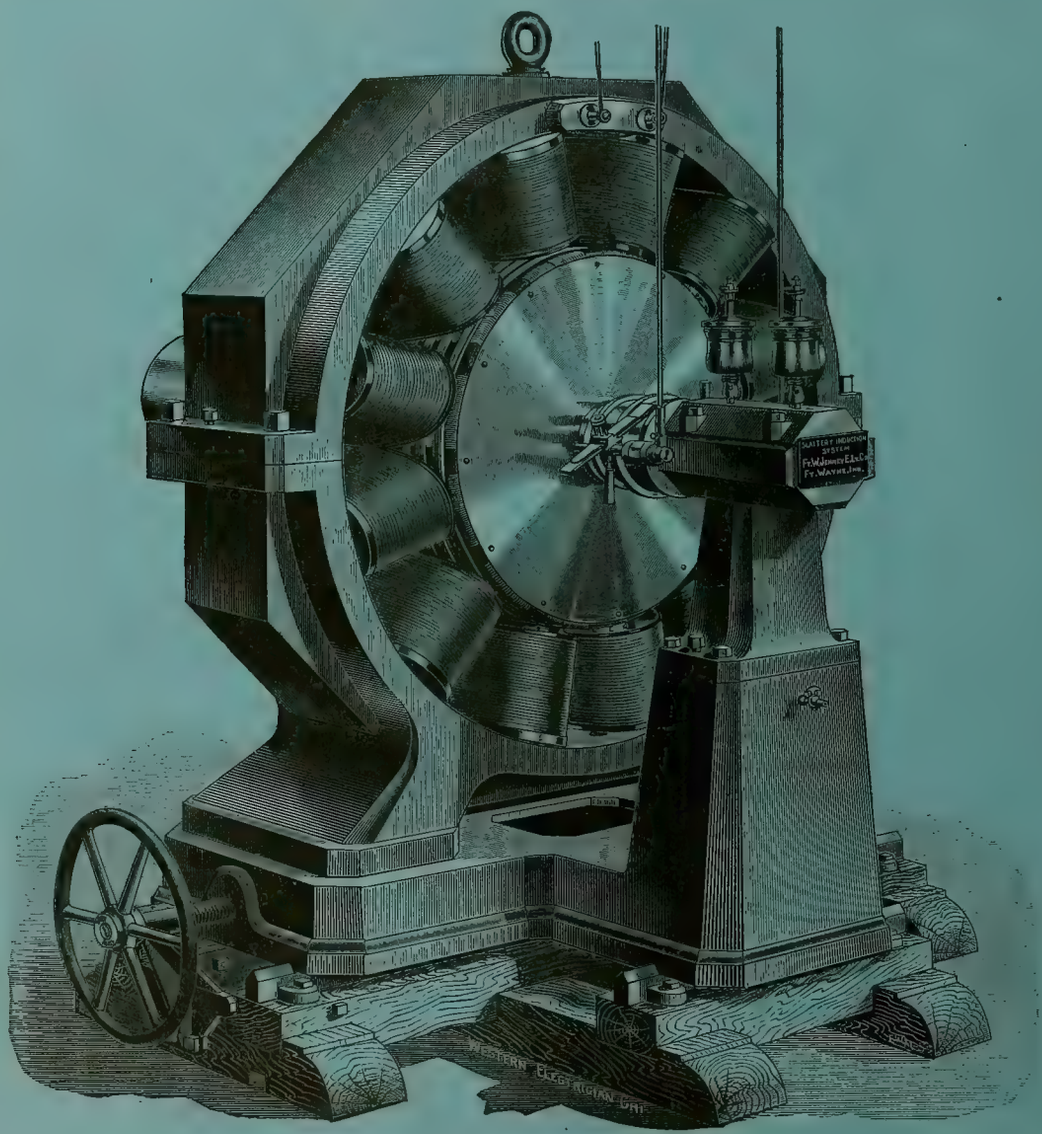

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EVERY SATURDAY.

Vol. II. CHICAGO, MARCH 17, 1888. No. 11.

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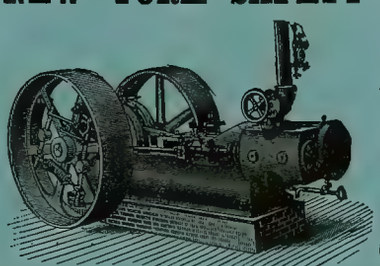

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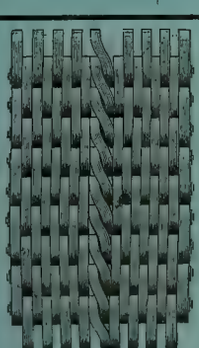

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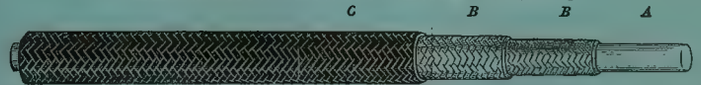

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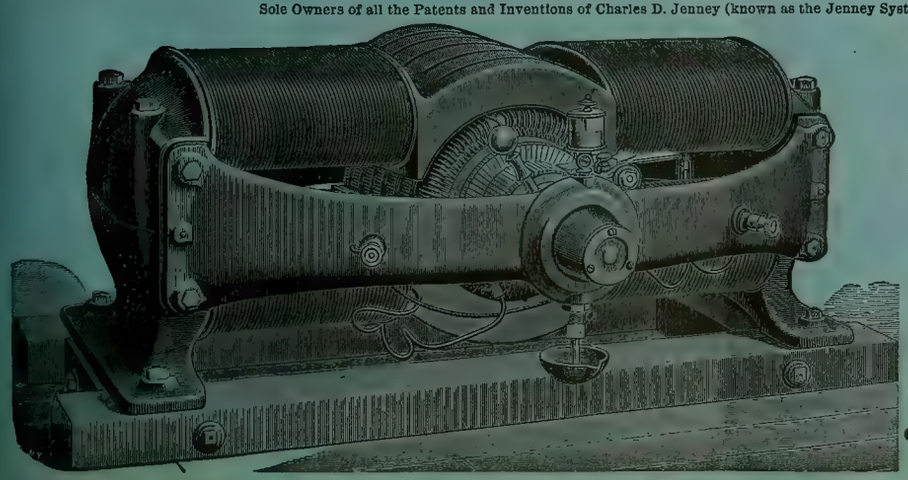

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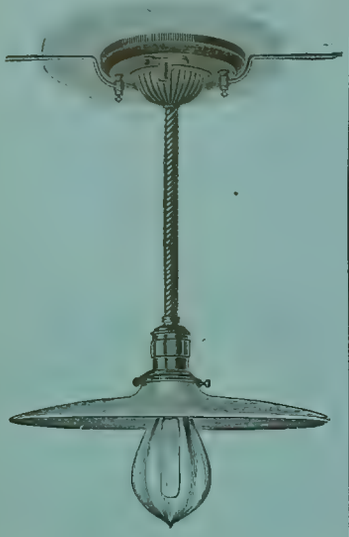

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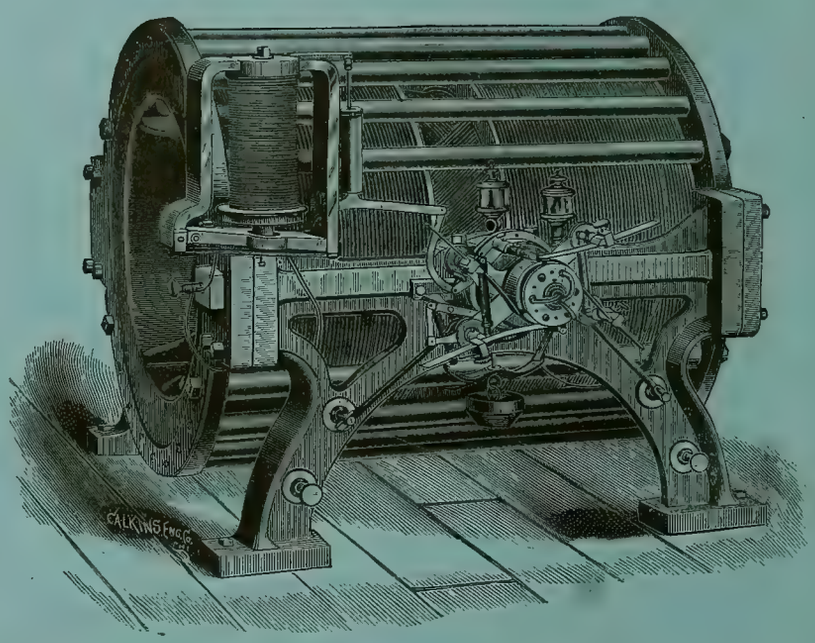

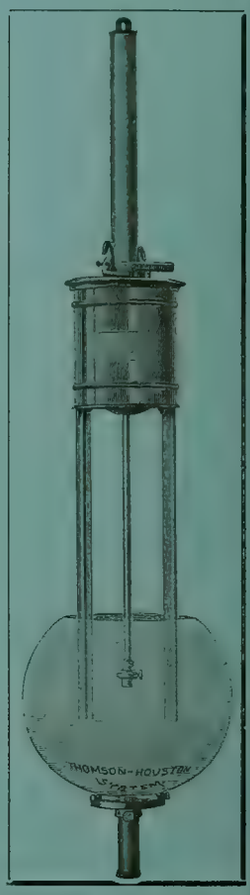

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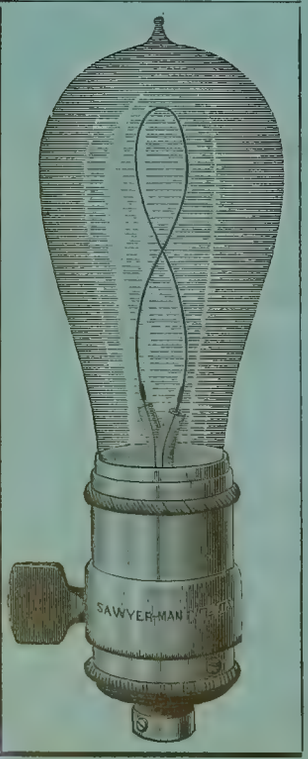
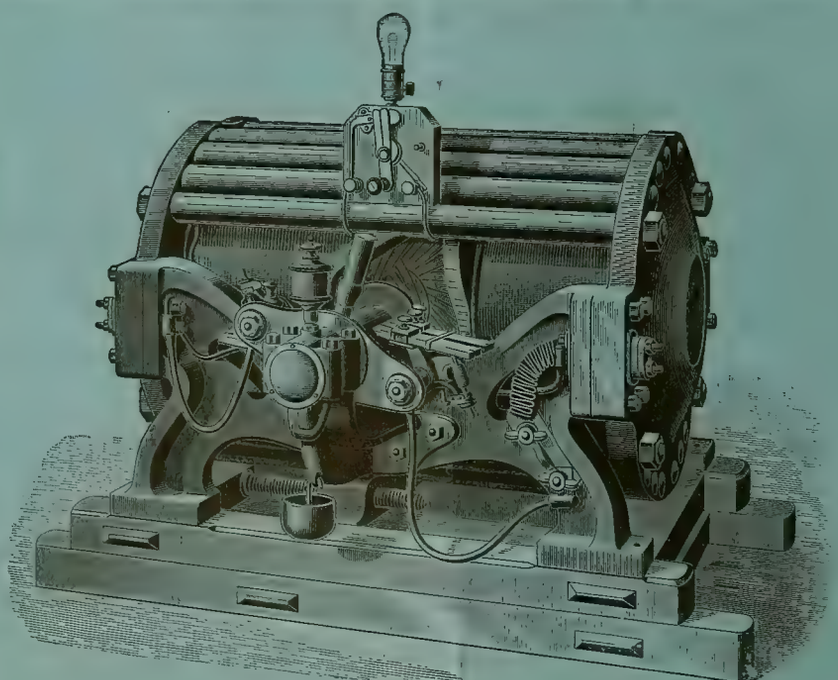
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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EDISON'S NEW LAMP.

Guaranteed Economy 12 16-Candle Power Lamps per Commercial Horse Power. Guaranteed average life, 600 hours.

EXTRACTS FROM LETTERS OF LAST MONTH RELATIVE TO

PLANT IN PEOPLE'S THEATRE, MINNEAPOLIS

Feb. 23, 1888.

"I have read the statements of my electrician and engineer regarding the electric light plant put in my theatre some three months ago by you, and wish to say that I fully endorse all that they have said, and would say more if I thought it necessary. * * * The best indorsement I can give you is to say that if I were to purchase another plant, I should certainly select the Edison system. * * *

Yours truly, LAMBERT HAYS, Proprietor People's Theatre."

Letter from Edward H. Chase, Electrician, People's Theatre, Feb. 23, 1888.

"* * * In regard to life of the lamps, I can say that in my opinion they are lasting far better than I was led to expect. * * * We have 529 sixteen candle power lamps burning altogether in the plant, and we average five hours burning each day. We started up on the 31st day of October, and have run every day since. * * * This makes 120 days of running, and during that time we have only burned out 70 lamps, which I consider a wonderful record so far. I would like to state that I was led from the talk of agents of other companies to think that the lamps would become black after being run a short time. This is not the case. * * * We do not possess a single lamp that is at all black. I have tested the electromotive force on the lamps on the different circuits throughout the plant, and find there is not a variation of over half a volt. * * * It is certainly the finest equipped and working plant in this city, and one of which you should certainly feel proud. * * *"

Letter from Wm. D. Stevens, Engineer People's Theatre, Feb. 22, 1888.

"The electric light plant in People's Theatre started Monday, October 31st, and has been running continually since that time. I have yet to find a flaw in its construction. * * * There has been absolutely no trouble whatever with the dynamos since they were started; and I wish to be emphatic in what I say, as I have heard that the opposition electric light companies assert that the plant is not working at all satisfactorily. I am running two incandescent light dynamos—Edison System—of 250 lights capacity each, with a high speed automatic engine of the Ide make. * * * The engine is developing with the entire load of 529 sixteen candle power lamps, about 45 horse power, which is doing better than represented. * * * The plant is visited by a large number of people, principally Engineers, and they all pronounce it to be one of the most beautiful running plants they ever saw. The working of the dynamos is simply perfect. There is no sparking of the brushes, and the commutators are at present as smooth as glass. * * * This is not the first experience I have had in running electric light, and think I am competent of judging whether the same is operating as it should. I am safe in saying that there is not a better or more satisfacrory working plant in this section of the country. * * *"

Letter from F. C. Hughes, Electrician, Pillsbury Mills, Minneapolis, Feb. 24, 1888.

"I have, at your request, made an examination of the electric light plant at the People's Theatre, and found it in good running order. * * * I visited the plant several times, both when running and when it was being wired, and I consider it the best lighted, and has the most complete regulating devices in the city, and great credit is due to the parties for the manner in which the plant is constructed."

Plants Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

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610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
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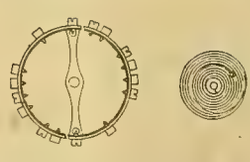

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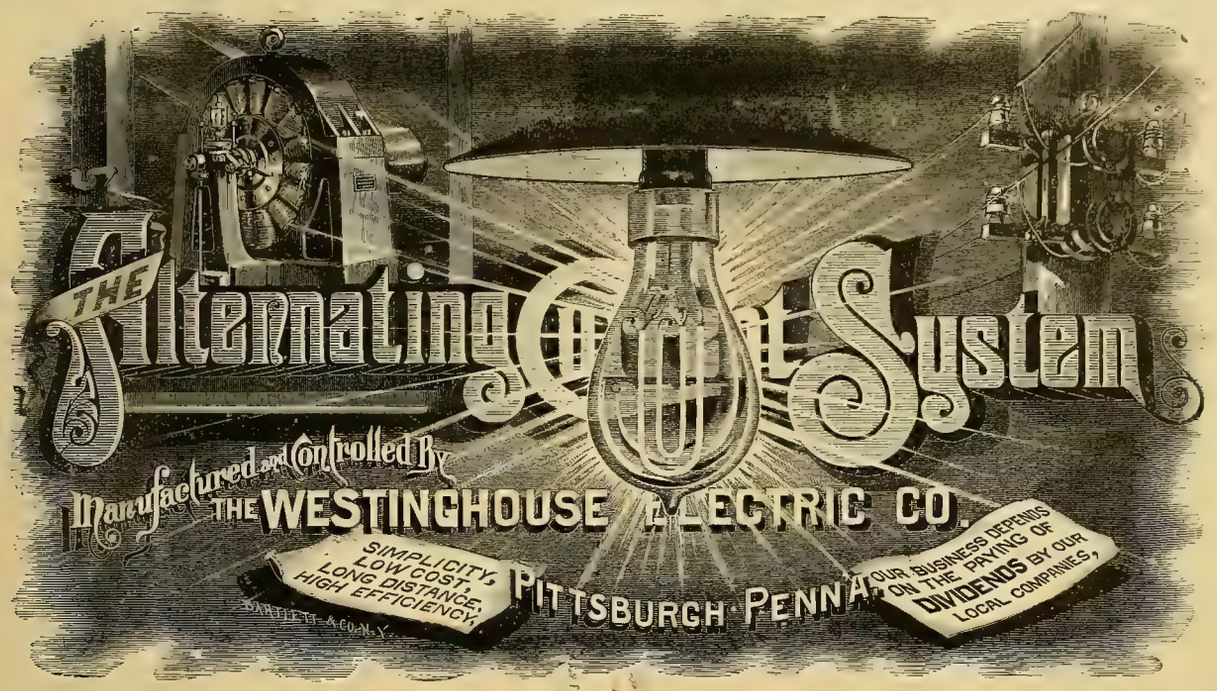

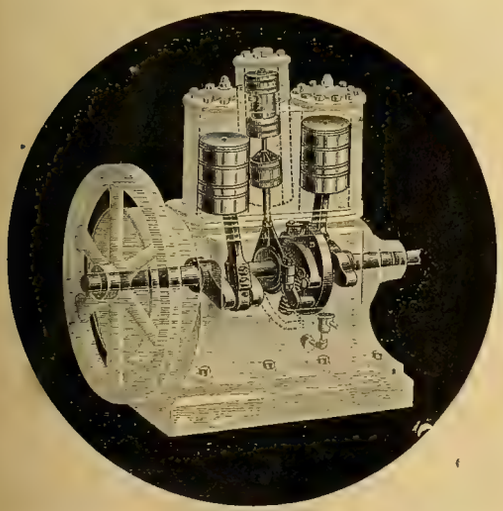

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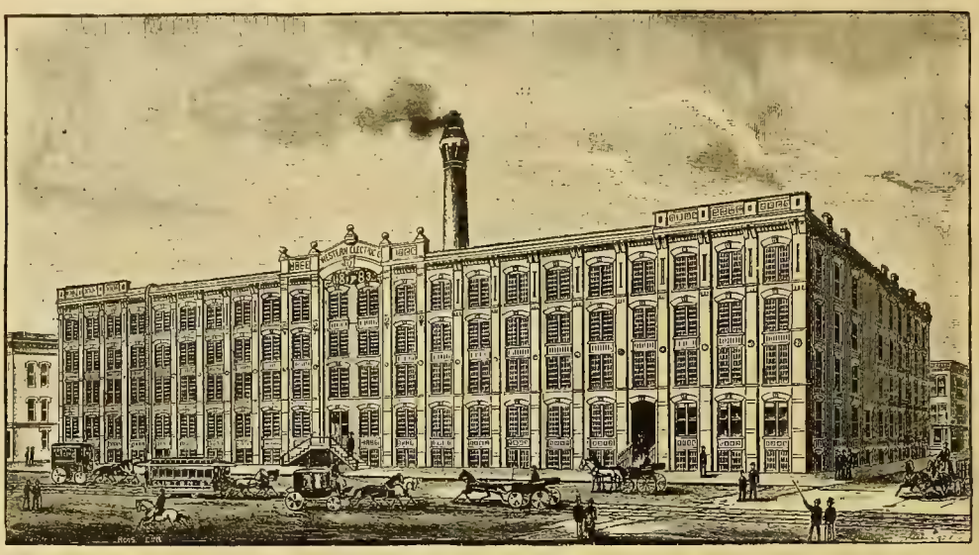

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Vol. II. CHICAGO, MARCH 17, 1888. No. 11.

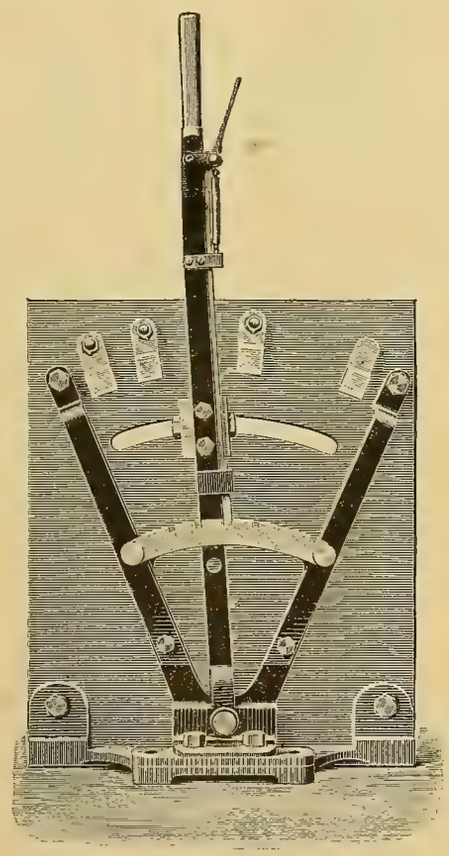
Main Switch for Electric Railways.[1]

The illustration represents a main switch for electric railways. The great difficulty met with in switches for electric traction work is that of excessive sparking. This is due not only to the large power which has to be transmitted through the switch, but chiefly to the fact that the circuit necessarily has much self-induction. When an electric current is used only for lighting, the self-induction is comparatively small, and may, in the case of glow lamp installations, be quite negligible. A fairly strong lighting current may therefore be interrupted by a switch of ordinary construction without excessive sparking; but when the current is used to operate an electromotor in which the self-induction of the field magnets and armature is considerable, a heavy flash is produced upon breaking the circuit. It is, of course, impossible to entirely avoid sparking with any construction of switch, and the only advantage which the designer of a switch can employ is that of letting the spark be produced in a place where it is not injurious. In other words, the spark must not be allowed to take place between the working contacts of the switch, but between special sparking pieces which may be easily replaced. Such sparking pieces are now also put on the better class of electric light switches, where they are of metal; but in the switch we illustrate the sparking pieces consist of short and stout carbon pencils. We may mention that, some years ago, Messrs. Siemens introduced a switch designed on the same principle; in this the connection was first broken by the working contacts on the face of the switch, and afterwards between two carbon pencils behind the face. Switches for electric tram cars or railways must be designed to permit of the breaking of a considerably larger current than that nominally required to work the car. When first starting the car, the current is necessarily in excess of its normal value, and if, a few seconds after starting, it should be required to switch off, the switch must be able to break this excess current without being injured. The switch we illustrate is intended to break a current of 200 amperes flowing under a potential difference of 300 volts. The face of the switch-board is of slate, set in a cast iron frame about 2 feet by 3 feet, and there are five contacts on the face, four of them with terminals at the back, which take the leads to the artificial resistances in the usual way. The switch-lever is pivoted at the bottom and provided with a spring catch and segment similar in construction to that used on locomotives. About the middle of the lever there is an insulated piece forming one pole of the switch. This piece is in connection with the metal contact piece behind the lever, but in front of the face of the board, and with a carbon pencil behind the board, the metal stud which carries the carbon holder passing through the segmental slot shown in the illustration. At the back of each of the four contacts is another carbon holder, and the carbons are so set that the carbon on the lever can not pass them without deflecting each through a certain arc, a spring attachment on each carbon holder being provided to bring it back to the radial position after the lever has passed. By this means the break on the back of the board occurs after the working contacts on the face have already been separated. The switch board is intended to be fixed on the front platform to the right of the driver, so that he may work the lever with his right hand, as is done on locomotives.

1 *Industries*, February 24th.

Electrical Bullet Probe.

The construction of Dr. Girdner's electrical bullet probe, described at a recent meeting of the New York Academy of Medicine, is as follows; To each of the two terminals of telephone receiver, an insulated flexible wire, about four feet long, is connected. At the free end of one of these wires a hollow, bulbous piece of steel is attached. At the free end of the other wire is a suitable handle in which a probe may be placed, and held by a clamp screw. The internal arrangement of the handle is such that a perfect electrical contact exists between the end of the probe and that of the wire which terminates in the handle; the same is true for the end of the other wire



and the steel bulb. When a current of electricity is passed through the coil in the receiver by means of the bulb, and the probe, each time that the current is made and broken a clicking or rasping sound is heard in the receiver held to the ear. All sounds are shut out except that heard when the bullet is touched; and the apparatus is so constructed that both hands are left free. In describing the application of this probe, Dr. Girdner mentioned a case seen in practice, in which a musket ball had lain between the bones of the leg for twenty-two years. When an ordinary probe was passed, hard substances could be felt in many places, but it could not be told whether they were bone or bullet. The porcelain probe, invented by the distinguished French surgeon, Nélaton, was of no use, as the bullet was so covered by a thick crust of salts of lead as not to be marked when it was rubbed against the bullet. When the telephonic probe was passed, no response came so long as bone and other tissues were touched; but, the moment the probe came in contact with the bullet, a clicking and rasping sound was heard in the telephone. During this test the steel bulb was held in the patient's mouth.

Magneto Bell Test.

M. A. Knapp, of the Railway Telegraph Supply company, of Chicago, made a test of a long distance telephone on the Postal Telegraph wires on a recent Sunday. The points between which communication was attempted were Chicago and New York. The message was sent by telegraph that conversation would be attempted, but that part of the test was unsuccessful. Mr. Knapp was delighted, however, to find that his magneto bells responded when the New York operator rang him up. In speaking of the test, Mr. Knapp said, "I have not yet found any one who believes that the bell rang, but I can assure you it was a fact. Of course everything combined in our favor. The wire which was used is heavy copper. The bells were not made for the test, but were taken from our ordinary stock. To tell the truth, I did not imagine that the bell could ring, but it did."

Electric Railway at Richmond.

The electric railway at Richmond is running with the greatest success. Fifteen cars are operated on Sunday and twelve on other days. On Sunday, February 26th, the receipts averaged $25 per car. A telegram was recently sent by a president of a street car railway company to John F. Barry, treasurer of the Richmond Union Passenger Railroad Co. asking for his opinion of the electric railway. His reply was as follows: "Am very much pleased with its working. It is working well." In his letter addressed to the same gentleman Mr. Barry spoke in the highest terms of the Sprague motor, which is employed on the road. He says: "It has been subjected to a very severe test in Richmond, both in the way of heavy grades and sharp curves and its success is assured." The Wilmington, Del., city railroad company which has been running trial trips with an electric car opened the car for business Monday.

Telegraphing By Induction.

An operator who had charge of the instrument for telegraphing by induction from the Lehigh Valley train was recently interviewed by a New York *Sun* reporter. He said; "The advantages to the passengers are very great. Every trip numerous passengers send messages by me. Some of them are of such a nature that it would be quite a serious matter for the sender to have to wait until the next stop to send them. Of course, on some of the fast trains, that do not make any stop at all for hours, the importance is increased. Passengers may send messages from the car to any point reached by the Western Union, and can similarly receive messages from any such point. A lady was taken sick on this train going out to Easton the other day. I used my instrument, and when the train stopped there was an ambulance and a physician waiting for her. We had hardly pulled out of Newark yesterday when the conductor received a message from a lady who had got off there, asking him to look out for her satchel, which she had forgotten to take with her."

"What does the system cost?"

"It costs about $15 to equip each car, but only one car on a train has to be equipped. The outside line costs $50 a mile, including labor and all. When the old line is near the road it is not necessary to erect a new one. But it would soon pay for itself by the advertisement

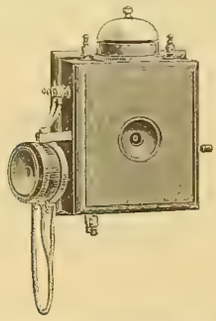
that it would give the road. If passengers knew that they were to be kept at all times in connection with the world outside of the car in which they ride, and that their safety is looked after as carefully as possible, by connecting their conductor with the conductors of all other trains for miles and with the dispatcher, they would have less fear of danger from collisions and other accidents."

Natural Gas Rivalled.

A. J. Simmons, of Indianapolis, asserts that he has discovered a method of economizing fuel by which the use of coal will be made cheaper than natural gas. He gives the following explanation: "I discovered that the atomic movement of flame and electricity is the same and that it can be insulated. On the other hand, while the atomic movement of magnetism and radiant heat is the same it can not be insulated. Faraday was the first to discover the mechanical effect on flame. My discovery relates to the chemical effect, which is the superoxide of oxygen, generally known as ozone. I placed an iron bar in the bridge wall of a furnace, and by varying the magnetism in the bar found I could distort the flame at will. For this purpose in my first experiment I used a dynamo, but afterwards, trying the cell system, obtained effects nearly equal to those from the dynamo. Through a process known only to myself, and which I will not patent, the flame produces a magnetic prestige which brings down the oxygen, the life of all fires. When properly fired no smoke is emitted, because the same process exhausts the hydrogen, the one great element of smoke."

Inter-State Telephone Company.

The Inter-State Telephone company of Chicago is endeavoring to secure an ordinance giving the corporation permission to introduce its system in the city. In its application the company states that

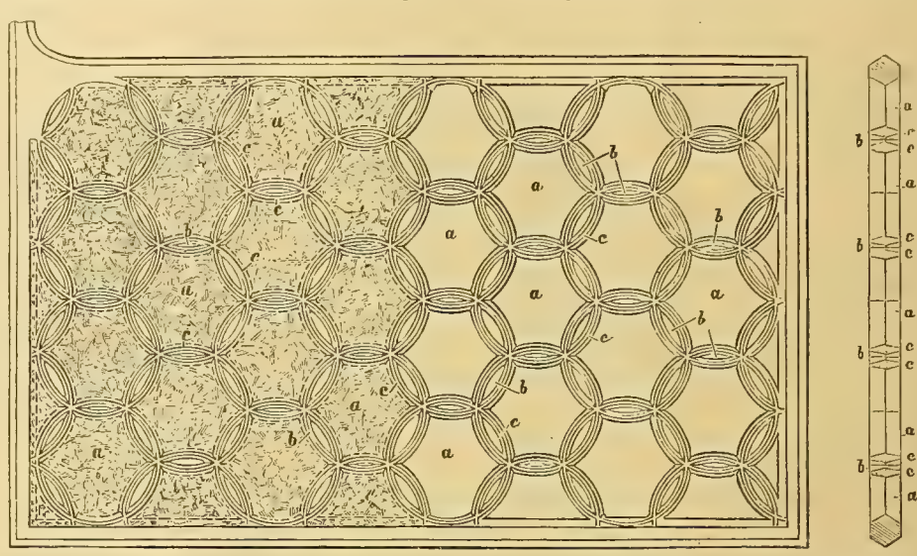


it proposes to charge subscribers $50 per year rental. The company uses the Hopkins telephone, shown in the accompanying illustration, with the discontinuous circuit. The instrument, the officers say, can be made much cheaper than any other instrument and consequently the company can afford to charge a much lower rental. If the company receives the desired permission the work of securing subscribers and putting in instruments will be immediately begun. The officers of the company are: President, Charles M. Partridge; vice president, Thomas B. Gault; secretary Samuel C. Heald; treasurer, B. Sherman. The company, the officers say, has plenty of available capital to put a plant into thorough working order in this city and to push the business into other states as it is proposes to do at an early date.

Farbaky & Schenek's Accumulator Plates.[1]

The object aimed at in these plates is so to construct or manufacture them that the active material does not expand so as to break the frames. The material used does not fill up the lead frame, but is divided by gaps or holes which may be conveniently arranged so as to form regular divisions in the grating. By means of this improvement the durability of the plates or elements, and consequently that of the accumulator, is claimed to be greatly increased.

The cause of the gradual destruction of the lead frames of the plates, under ordinary conditions, is that the active material increases in volume to a considerable extent, although slowly, and by continually expanding and stretching the frame produces cracks or flaws in the latter. When the protecting crust of crystalline oxide of lead breaks away from the lead, the sulphuric acid or electrolyte and the electrolytically generated ozone obtain free access to these cracks, and this occurs after a time at numerous places, so that the continuity of the lead frame is ultimately broken and its conductivity destroyed, the plate or element finally falling to pieces. This is prevented in Farbaky & Schenek's plates by employing in place of gratings formed by straight bars crossing one another, a frame formed by intersecting rings or divisions forming polygonal spaces for the reception of the active material with gaps or spaces between, which are unoccupied. The illustration shows a side elevation and transverse section of the new form of plate



or element, in which it will be seen that the rings, *c*, forming the grating are so arranged that polygonal spaces at *a* are formed for the reception of active material, the spaces at *b* being left empty.

In this form of construction the augmentation in volume of the active material takes place without injury to the plate or element, as the unoccupied spaces, *b*, permit of the expansion of the contents of each space, and the divisions are not stretched but rather compressed, so that the frame as a whole undergoes practically no alteration in its form, and is thereby protected to a considerable extent from deterioration. It will be evident that the divisions may be of other shape than circular, provided that there are the spaces for the active material with unoccupied spaces between.

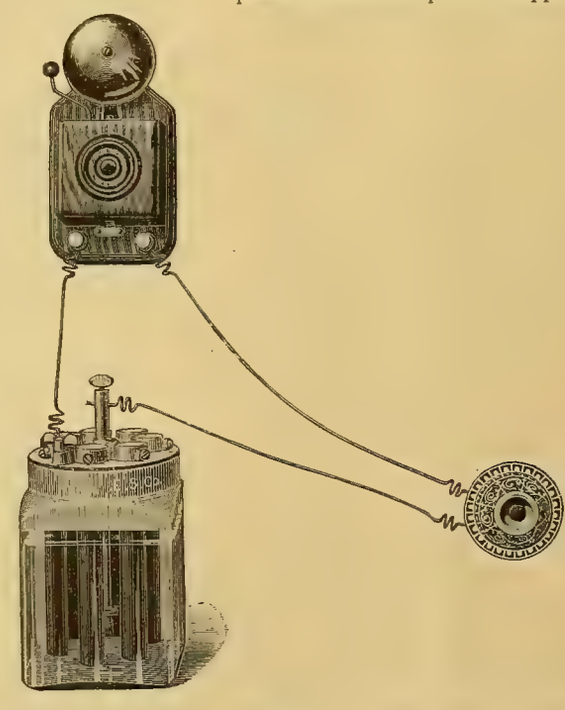
[1] London *Electrical Review*, February 24th.

How to Connect an Electric Bell.

To the Editor of WESTERN ELECTRICIAN:

BRIGHTON PARK, Ill.—Will you kindly let me know through the columns of your paper how to connect an electric bell. NATHANIEL DICKEY.

[We infer that our correspondent wishes to know simply how the connections are made. If so, a graphic representation will be of more service than explanation in words. Consequently we give space to the engraving in connection.] — Ed.



The Elements of Electric Lighting.

By PHILIP ATKINSON, Ph. D.

NUMBER XXXIII.

CONSTRUCTION OF THE INCANDESCENT LAMP CONTINUED.—It will be seen from Figs. 74 and 75, which represent different styles of the latest Swan lamp, that the method of mounting the lamp and connecting it with the electric circuit is essentially the same as that of the Weston and Edison, as shown by the description and illustrations already given; the bulb with its inclosed filament, platinum wires and connections, and brass collar, forming one part; and the brass tube to which it is attached as shown, containing the apparatus for opening and closing the circuit by an insulating handle, forming the other part. This apparatus may be varied indefinitely; its construction being a mere matter of mechanical detail.

The position of the lamp is entirely a matter of convenience; it may be placed with the bulb above or below the point of support; in a vertical position, or at any angle required for the radiation of the light in any desired direction. In this respect it has greatly the advantage of the arc lamp, which practically requires a vertical position below the point of support, and casts a shadow on the spot directly underneath, while an incandescent lamp, in the same position, casts no downward shadow.

As the rupture of the filament renders the hermetically sealed bulb useless, a method has been patented by which the bulb is closed by a

stopper having an elastic packing designed to render the joint air tight, so that the same bulb, with its stopper and connected wires can be used again by attaching a new filament. This method has evidently not been found practical, since it has not come into use; and it is doubtful whether it would be possible to render such a method practical, or to gain any advantage from it. The packing should exclude the air as perfectly as the hermetical sealing by fusion of the glass, and be of such quality as to resist deterioration from the alternate heating end cooling of the bulb. The exhaust vent would require to be closed in a similar manner unless made through the stopper; and as the stopper with its connected wires is more expensive than the bulb, the economic advantage of closing a vent through it, in the same manner, is apparent, since the hermetical sealing of a vent through stopper or bulb by fusion of the glass renders either practically useless for the introduction of a new filament.

FIG. 74.

If the expense of re-fitting incurred by this method should prove equal to that now incurred by the loss of the hermetically sealed bulb, there would be no advantage in its adoption. This expense would include the removal of the black deposit from the interior of the old bulb, the removal of the packing, removal of the old filament and attachment of the new, and the exhausting.

The loss of the bulb itself is insignificant, since its value is no greater than that of any ordinary glass bottle of equal size and quality, and the platinum wires are easily removed from old stoppers by fusing the glass. The principal loss is the time and labor expended in fitting up and exhausting the lamp, which, including the items mentioned above, would be practically the same for renewing an old lamp by the proposed method as for preparing a new one by the present method. The present charge to the consumer for a new 16 candle lamp, to replace an old one, after deducting rebate for platinum wire of old lamp, is about 70 cents.

It is an interesting fact, in this connection, that if the ends of a broken filament can be interlocked, as may often be done by jarring the bulb slightly, especially with filaments of the corrugated or spiral form, the light can be renewed, and such filaments often do good service for a long time.

Electrical Distribution by Means of Transformers.[1]

By J. KENNETT D. MACKENZIE.

PART II.

With regard, now, to the practical working out of a system of supply based upon parallel transformers, I will endeavor to show what has hitherto been done, the methods employed, and the results obtained. The dynamo here claims our first attention, and, being the generating source of supply, forms, perhaps, the main feature in an electrical installation. In the first place, it must necessarily be of what is known as the alternating type. Up to very lately this class of machine had in this country received but a small amount of attention; now, however, since the transformer system has become known and appreciated, several makers have gone into the subject, and many marked improvements have resulted. One of the chief of these is the employment of iron in the armature, and such good results have been obtained by making the mass of iron very considerable in both armature and field, that this plan is now regularly adopted. One of the most important points in this class of machine is self-regulation, more especially with regard to small variations in potential; the changes of load occurring on a supply system, which produce extensive alterations in the external resistance of the circuit, and consequently large variations in potential, being easily met in other ways, such as by the introduction, either automatically or by hand, of resistances into the exciting circuit, or by varying the speed of the machine itself. As much as 2 volts per foot of wire may be obtained from the armature of a dynamo without any very considerable speed; and as it is of importance to get this amount, if not more, when we remember that the magnetizing effect of the current in the armature coils, as well as the amount of self-induction, is proportional to the number of turns in the coils. Now, since both are objectionable when amounting to much, high e. m. f. and steadiness of potential may be obtained by greatly increasing the mass of iron so that half saturation is never exceeded. Some very large alternating current dynamos are now in use in this country, probably the largest being those by erranti, employed at the Grosvenor gallery central station. Others, by the same maker also, are now in hand for the new supply works of the London Electric Supply corporation limited, at Deptford, whose dimensions appear rather formidable.

Their armatures are to be, I understand, about 42 feet in diameter, and will be driven direct from quadruple expansion compound surface-condensing engines of a marine type, indicating 5,000 h. p. each.

A type of alternating current dynamo founded on a system previously known and patented, has lately been altered so as to render it workable and efficient by Mr. Kingdon, who, early in 1886, submitted to me his ideas upon the subject. Those who had previously worked in the same direction had failed to make a serviceable machine from having overlooked the importance of laminating all the iron acted upon electrically, as well as other minor details requisite to make the idea practicable.

A series of bobbins, whose cores form parts of one whole continuous iron structure made of laminated soft iron plates, are divided into two divisions; one of these is rendered magnetic by separate excitation, and the other is acted upon inductively by the revolving laminated inductors, which may form part of the fly-wheel of an engine. It will be seen that if the bobbins of the first division be coupled up and excited they will each have an alternate polarity, and that if an iron armature or inductor be placed across the pole of one of these bobbins and the pole of the next non-excited bobbin, a current will be set up in the wire forming this second bobbin, which current will tend to make its core of an opposite polarity to the one next it, and which is joined with it by the inductor. As the revolving inductor alternately connects the induced bobbin with its neighbors, each of which has an opposite polarity, it follows necessarily that the current that will flow in the induced bobbin will be alternating.

I would draw your attention here to one striking feature in this machine, viz., that the same mass of iron serves both for the field magnets and the secondary coils, these all being, so to speak, prolongations of teeth of the iron mass. A series of alternate bobbins, excited and not excited, if magnetically connected in this manner by revolving inductors, will yield a current from those bobbins not separately excited, which current will depend for its value upon the strength of the magnetic field due to the excited bobbins, the size of the induced bobbins, the quantity and dimensions of the wire thereon and the speed at which the inductors revolve.

Experiments made with a dynamo of this nature have so far given very good results, some of the main advantages that may be claimed for such a type of generator being that there is no revolving or moving wire, no collectors and consequently loose contact; that the machine may be divided into separate circuits, which, by means of a switchboard, can be easily varied; and, lastly, that very

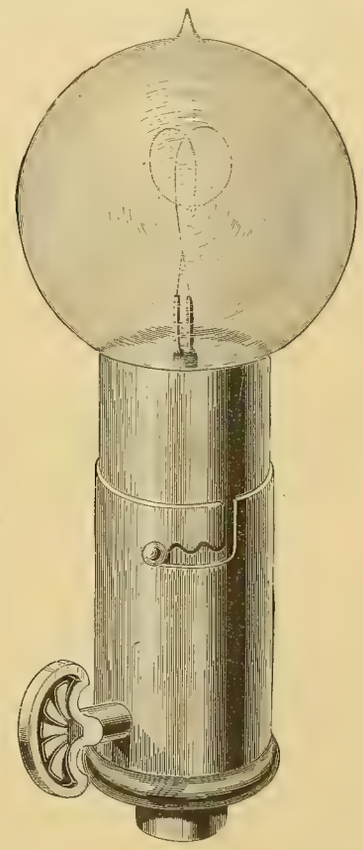


FIG. 75.

great simplicity of construction, and consequently low cost, is obtained. The fly-wheel of the engine may carry the inductors, and as this can easily be made of very great size, slow-running machinery may be employed, with its consequent advantages.

In designing supply works for electric lighting on a large scale, I am of opinion that employment of a few very large dynamos, instead of a larger number of smaller ones, is a mistake, and that, generally speaking, the output from each dynamo should not exceed 10 per cent. of the total capacity of that particular station. In all running machinery, be as careful as one may, accidents will happen; hot bearings will, when least expected, occur; and with a heavy load on an engine running under such conditions serious damage may be caused, while, if a stoppage be made, a very heavy proportion of the total output will be affected. It is true that with a larger number of small engines the initial cost is greater, the depreciation greater, maintenance and attendance more costly; but, nevertheless, I am inclined to think that these disadvantages are more than counterbalanced by the greater security gained in subdividing the producing plant to a larger extent, especially when it is remembered how important it is in works of this nature that no break-down in the supply should occur.

(*To be continued.*)

Dynamo Tenders' Hand-Book.[1]

By F. B. Badt.

PART I.

ELEMENTARY DATA.

Chapter I.

The Electric Current.

In order to understand the action of what is called the electric current, we will consider two reservoirs of water connected by a pipe, Fig. 1. The electric current may be likened to the flow of water through this pipe from the higher to the lower level.

The unit of current strength, also called the rate of flow, or intensity, is the ampère. In the illustration we would

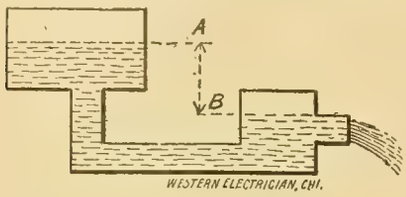


Fig. 1. — Reservoirs of Water.

say the water is flowing through the pipe at the rate of one gallon per second. In speaking of the electric current we would say it has a strength of, say, one ampere.

The unit of electromotive force, also called electrical pressure, or tension, or difference of potential, is the volt. In the illustration the head of water, or the difference between the levels *A* and *B* is similar to the electromotive force.

The unit of resistance is the ohm. Resistance may be compared with the friction of the internal surface of the pipe offered to the water. It follows that the more cross-section the less friction, and the less cross-section the more friction, for the same volume of water flowing through the pipe in a given time.

In the following, only the terms, current strength, electromotive force—frequently written e.m.f.—and resistance, will be used.

Chapter II.

Ohm's Law.

Ohm's law expresses the relation of current strength, electromotive force, and resistance, to each other. It says: Current strength equals electromotive force divided by resistance. We can write this $C = \frac{E}{R}$, C standing for current strength, E for electromotive force, and R for resistance.

Chapter III.

Work.

The work accomplished by electricity is expressed in volt-amperes or watts. The product of so many gallons per second and the difference between the two levels *B* and *A*, would give us the work accomplished by the water in illustration, Fig. 1. The same work can be done with great current strength and low e.m.f., or with small current strength and high e.m.f. For instance, 100 amperes × 10 volts = equals 1,000 watts; or, 10 amperes × 100 volts = 1,000 watts.

One electrical horse power equals 746 watts; hence the electrical work of a dynamo may be expressed:

H. P. $= \frac{\text{amperes} \times \text{volts}}{746}$. The number of mechanical horse power necessary to drive a dynamo is generally 10 to 20 per cent. higher than the electrical horse power yielded by the dynamo.

Chapter IV.

Conductors and Insulators.

Bodies in which the current moves freely are called conductors, and those in which it does not move freely are called insulators. Examples of conductors: Metals, solutions of chemical salts, moist earth, etc. Examples of insulators: Porcelain, rubber, gutta percha, sealing wax, dry wood, etc.

Chapter V.

Direction of the Current.

For convenience sake we assume that the electric current flows from the positive pole of a galvanic cell or any

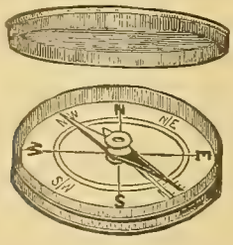


Fig. 2. — Pocket Compass.

other generator of electricity, through the external circuit back to the negative pole. In order to find the direction in which the current is passing through the wire, we place a pocket compass, Fig. 2, *under* the wire, Fig. 3. The north-seeking pole of the needle, called the north pole, and distinguished either by a different color—blue, for instance—or by a little brass rivet, will be deflected to the *left* when the current flows in the direction of the arrow, Fig. 3. Or, in other words, the positive electricity enters at *A* and leaves at *B*.

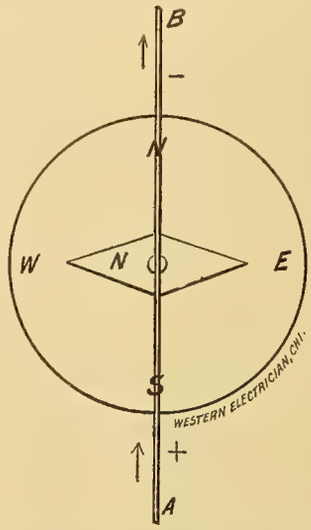


Fig. 3. — Compass under the Wire.

When the compass is held *above* the wire the north pole of the needle will be deflected to the *right*.

General rule: Think yourself swimming in the current always facing the needle. The positive current entering at your feet will cause the needle to deflect to your left.

Another general rule: Think of the word Snow. With the wire over the compass the current flowing from the South to the North will deflect the needle to the West; in other words, from S-outh to N-orth O-ver W-est.

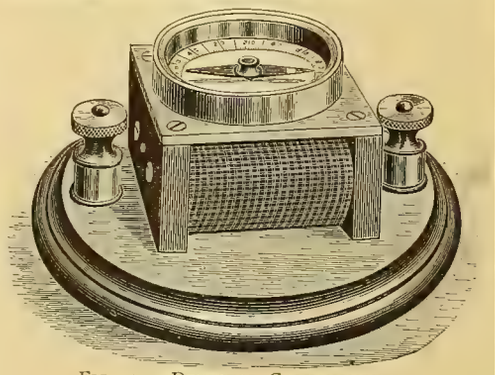


Fig. 4. — Detector Galvanometer.

The compass should be tested before these trials are made, as the polarity may have been reversed by the proximity of dynamo electric machines or other powerful magnets.

The binding post of the dynamo electric machine or battery from which the current starts is called the positive and is marked +; the opposite binding post is called the negative and is marked —. All indicators, lamps and other apparatus which are connected in the electric circuit must be marked accordingly; the binding post which should be connected with the positive binding post of the dynamo with + and the other with —. There are quite a number of instruments and electrical apparatuses, such as incandescent lamps, for instance, which may be inserted in the circuit either way. These, of course, need not be marked at all.

Chapter VI.

Detector Galvanometer and Magneto Bell.

The detector galvanometer, Fig. 4, in connection with

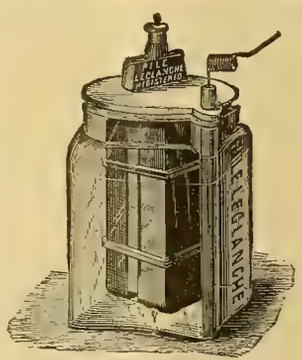


Fig. 5. — Galvanic Cell.

the galvanic cell, Fig. 5, is used for testing the insulation of the wires and apparatus and for locating other faults. The detector galvanometer is a compass mounted on a coil of wire. An electric current passing through this coil will deflect the needle of the compass, as has been explained in Chapter V. Of course, a coil will cause a greater deflection of the needle than a single wire as the current is forced to pass a number of times under the needle.

In order to test for insulation with the galvanometer, connect the galvanometer and the galvanic cell in series, that is, tandem—one behind the other, Fig. 6—and connect one wire starting from binding post *A* to a ground—gas pipe or water pipe—and the other starting from *B* to the wire to be tested for insulation. If the needle deflects, the wire is grounded; if it remains in its position the insulation is in good condition. It is well to connect wires *A* and *B* for a minute before testing, and see whether cell and galvanometer are in good condition. In connecting the wires

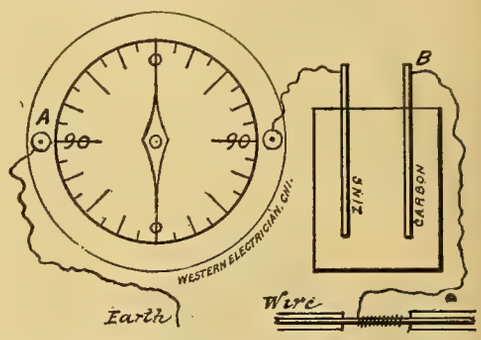


Fig. 6.— Galvanometer and Cell Connected.

the insulation must be carefully removed and the wire perfectly cleaned by scraping with a knife or by rubbing with a piece of emery cloth. Connections must always be made with clean metallic surfaces. In the same way a break in the circuit can be found. Cut the circuit in several sections and connect the ends of each section to *A* and *B*. When the needle deflects, there is no break in the circuit; if it does not deflect, the circuit is open.

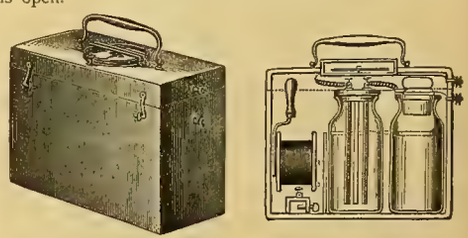


Fig. 7. — Portable Galvanometer, Battery and Wire.

Fig. 7 shows one form of portable galvanometer, combining galvanometer, battery and wire.

Very often a magneto bell, Fig. 8, similar to that used as a call for telephones, is employed for testing. When the bell rings the circuit is closed; if it does not ring the circuit is open. This is all it can tell, while the detector galvanometer, if properly handled, can tell very much more. A detector galvanometer can be carried in the pocket and rarely gets out of order, and a galvanic cell can be had almost anywhere. A magneto bell is a bulky apparatus and liable to get out of order at any time. The use of the galvanometer is preferable.

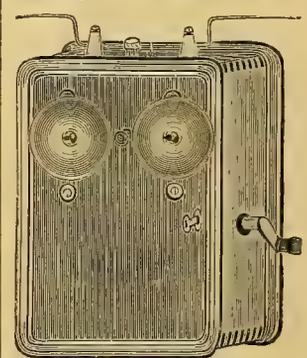


Fig. 8. — Magneto Bell.

A test with a cell and an ordinary electric bell cannot be considered reliable. Such a bell will ring only through a very low resistance, while a good magneto bell will ring through from 10,000 to 20,000 ohms resistance and a high resistance galvanometer with a powerful battery will deflect through millions of ohms of resistance.

THE ARRANGEMENT OF THE POWER.

Chapter VII.

The Dynamo Room.

It is best to have a separate room for the dynamo and the motive power, which generally consists of a steam engine. If more than one dynamo is to be used, it is also preferable to have them all in one room, as one man can more readily attend to them. The place where the dynamo is to be located should be dry and free from dust. A turning lathe should not be allowed near a dynamo, nor should the man in charge be allowed to file iron in its proximity.

Chapter VIII.

Motive Power.

The main thing to be considered in selecting an engine for an electric light plant is uniform speed. Any fluctua-

[1] Dynamo Tenders' Hand-Book, by F. B. Badt; 100 pages, 70 illustrations; flexible cloth binding; type page 6 x 3 inches; published by Western Electrician Co., price $1; now ready for delivery.

tion in the speed of the engine will show in the lights. Incandescent lights are more sensitive in this respect than arc lights. It is preferable to have an extra engine for the electric light machinery. If other machinery is connected with the engine, the sudden throwing on and off of machines will cause an irregular speed of the dynamo and very disagreeable fluctuations in the lights. The best power so far known to run electric light machinery is the modern automatic cut-off steam engine. The regulation of water motors, turbine wheels, etc., and gas motors, is generally not very satisfactory for electric light plants.

A good instrument for indicating the speed of a shaft or a dynamo at all times is the tachometer. It will show variations even within a small fraction of a minute.

Chapter IX.

Shafting and Pulleys.

The number of shafts should be reduced to a minimum. It is very convenient to use friction pulleys, if more than one dynamo is to be driven from the same shaft; by means of friction pulleys any dynamo can be thrown in or out at will. In calculating the diameter of the pulleys, it should be borne in mind that there is always a loss in speed caused by the slippage of the belt.

It is safe to allow about 2 per cent. for slippage for each belt. It is advisable to have the distance between the driving shaft and the shaft of the dynamo not too short.

A long belt will generally give better results than a short belt. The bearings will keep cooler, less oil will be used, and even with comparatively slack belts there will be little slippage.

On the other hand, short belts must be drawn very tight to prevent slippage. The boxes will heat, oil will be consumed faster, and the belts will be short lived.

Vertical belts must not be allowed; horizontal belts give the best results. Arrange the shafting to get the belts at an angle of at least 40 degrees with a vertical line.

If possible arrange to have the slack side of belt on top.

Chapter X.

Foundations for Dynamos.

A dynamo should be solidly set. Vibration caused by the rotation of the armature on a poor foundation may cause damages to dynamos in various ways. Especially larger dynamos, say from twenty-five horse power upwards, should be set on a solid brick or stone foundation.

The iron frame of a dynamo should be properly insulated from such foundations; this is generally done by a dry wood base plate. The upper surface of this brick or stone foundation should be at least one foot above the floor; this will enable the engineer or dynamo tender to keep the machine free from dirt, and will facilitate the inspection of the bearings, the commutator, and other important parts.

In a place where the noise caused by dynamos and engines would be objectionable, it is of importance to keep the foundations away from the foundation walls of the building. The counter-shafts must be set on the floor, and the floor above the dynamo room should be deadened.

Most dynamos are provided with a frame and a belt-tightening apparatus, which can be set on the foundation without any further preparations.

Chapter XI.

Belts.

The best belt to drive dynamo electric machinery is a light, double, endless, and rivetless leather belt. A single belt may be used for small dynamos, say, under ten horse power. Belts should always be made endless. A laced joint will show a fluctuation in the light every time it passes over the dynamo pulley.

It is advisable to run a new dynamo a day or two with a loose belt. In taking the measurement for a belt, the dynamo should be moved by means of the belt-tightener as near the driving pulley as possible; when this is done, it will be possible to utilize the whole length of the belt-tightener screw to stretch the belt. A belt should never be tightened any more than enough to prevent an excess of slippage. Any belt will slip a little, but this slippage should not exceed 2 per cent.

DYNAMO ELECTRIC MACHINES.

Chapter XII.

Description of the Dynamo.

A dynamo consists of the field and the armature. The field consists of the magnets, which are solidly connected with the iron frame. The magnets are iron cores, on which layers of insulated wire are wound. These magnets belong to the class of electro-magnets, as they become magnetic only when the current is passing through their coils. Between the poles of the magnet the armature rotates. The armature consists of an iron or steel shaft, to which a number of coils of insulated wire are affixed.

Metal plates or bundles of wire called brushes conduct the current generated in the armature to the lamp circuit.

The two main types of dynamos are:

A, The continuous current dynamo. The current generated in this dynamo always flows in the same direction. The armature of this dynamo has a commutator from which the current is taken off by the brushes.

B, The alternating current dynamo. The current generated in this machine flows at rapid intervals first in one and then in the other direction. This dynamo has no commutator but simply a collector consisting of two metal rings on which the brushes rest. The magnets of the alternating current machine require, however, a continuous current for excitation. This current is generated by an extra continuous current machine of small size, which is called the exciter.

Chapter XIII.

The Continuous Current Dynamo.

A, The series dynamo, Fig. 9. Magnet, armature and lamp circuit are connected one behind the other, that is, in

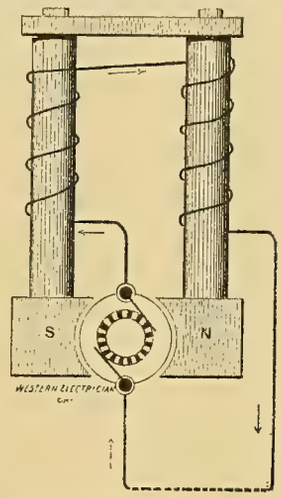


Fig. 9.—The Series Dynamo.

series; that is to say, the current generated in the armature passes in equal strength through field magnets and lamp circuit. These machines are mostly used for arc lighting.

B, The shunt dynamo, also called derived circuit dynamo. The coils of wire wound around the field magnets in this machine, Fig. 10, are connected in shunt or parallel to the brushes. Only a comparatively small part of the current generated in the armature is used for excitation of the field coils, while the greater part of the current is conducted

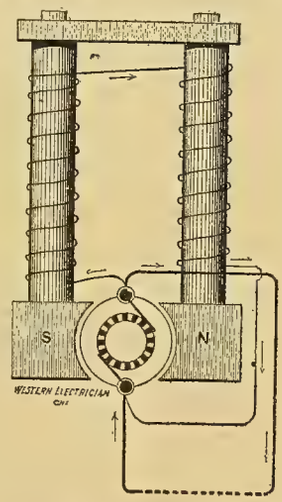


Fig. 10.—The Shunt Dynamo.

from the brushes to the lamp circuit. These machines generally have a resistance box, rheostat or regulator which is connected in the shunt winding of the field. By putting more or less resistance in the field of these machines the e. m. f. at the binding post of the machine can be decreased

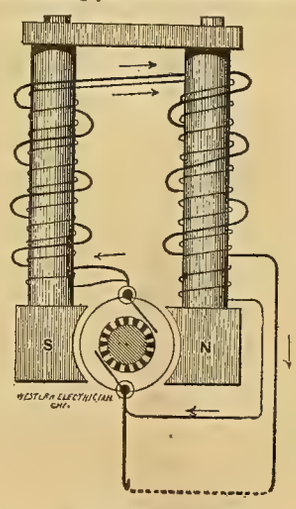


Fig. 11.—The Compound Dynamo.

or increased. Shunt dynamos are mostly used for incandescent lighting. In some systems, however, they are used for arc lighting also.

C, The Compound Dynamo. This dynamo, Fig. 11, combines in its fields the winding of both the series and the shunt dynamo. The magnets are wound with thick wire, which is in series with the armature and the lamp circuit. In addition they have a winding of fine wire, which is in shunt with the brushes. This dynamo generally has a resistance box put in the shunt winding of the fields, for the same purpose as explained under *B*. Compound dynamos are mostly used for incandescent lighting.

Chapter XIV.

The Alternating Current Dynamo.

The field wire coils of an alternating currrent dynamo, Fig. 12, have no connection with the brushes of the dynamo at all. The fields are separately excited, as mentioned in the foregoing, by a little continuous current dynamo, called an exciter. The alternating current machines were used formerly for arc lighting mainly—very little, however, in the United States—but recently have been introduced for long distance incandescent lighting by means of transformers or converters.

Chapter XV.

Preparation of a New Dynamo for Operation.

Iron parts which have to be fitted to each other must be carefully cleaned with fine emery cloth. When the armature is put into the dynamo, extra precaution is necessary in order to avoid any injuries to the insulation of the wire and to the commutator. The armature should be carried by a man on each end of the shaft. Heavy armatures should be supported by a board put underneath the armature, and each end carried by an additional man. Armatures weighing over 500 pounds should be handled by means of a differential block and tackle.

An armature should not be lifted by its commutator.

Some soft material, such as cotton waste or felting, should be put between the armature and the support.

When put in place in the dynamo the armature must not touch the pole pieces and must turn easily. There should be at least from $\frac{1}{16}$ to $\frac{1}{8}$ inch play between its bearings. This play or lengthways motion can generally be regulated by adjusting the collar on the shaft.

It must be borne in mind that the armature will warm and expand not only diametrically but also lengthways. If there should be no play, the armature might get wedged

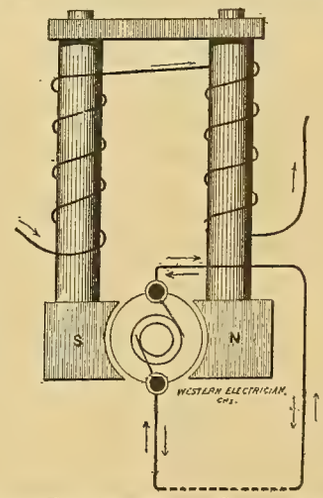


Fig. 12.—The Alternating Current Dynamo.

between its two bearings and cause hot boxes and stoppage of the dynamo. A swinging motion of the armature will cause the bearing to wear evenly, distribute the oil from end to end of the bearings, and prevent heating of the boxes. An armature can be caused to play only when the dynamo is in proper alignment and the belt not too tight.

All connections through which the current has to pass should be cleaned with fine emery cloth and should not touch any part of the iron frame or field-coils of the dynamo.

Chapter XVI.

Starting a New Dynamo.

It is advisable to run a new dynamo a few hours or even a day without any load, in order to test the lubrication, etc., not only of the dynamo, but of the engine, if it should be a new one. If everything is in good condition the load should be put on gradually. This can be done, either by running the dynamo below normal speed and gradually increasing the speed, or by using the resistance boxes and starting with very little current and gradually increasing it.

The latter is especially advisable for incandescent lamp installations. The testing should be made during the day. It will require for small plants a few hours; for plants of greater importance a few days; only when everything operates in good order should the regular running of the installation commence.

Every day before starting the dynamo, the dynamo tender should examine the binding posts, commutator and brushes. If the brushes are allowed to rest against the commutator, the engineer should be careful not to reverse the motion of his engine when starting, as he would spoil the brushes.

Iron nails, bolts and small iron tools should be kept away from the dynamo, as they may be attracted to the machine and damage it.

Oil cans for filling the oil cups of the dynamo should be of non-magnetic material (brass or zinc).

(To be Continued.)

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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THERE is considerable opposition to the copper ring in the French chamber of deputies on the ground that its object is to crush the smaller concerns. Those interested in the syndicate, on the other hand, contend that this statement is false and that the principal result of the combination will be the transfer of the copper market from London to Paris. They claim that the formation has already increased the public fortune in France 100,000,000 francs.

THE copper magnates in defense of their attempt to corner the market and maintain a price double that of the former figure, have assumed the role of philanthropists, and are attempting to show that the old price was ruinously low, and that all interested in the production and manufacture of copper are to be greatly benefitted by the advanced price. It remains to be seen whether the users of copper will take the same roseate view, and accord to scheming speculators the position of magnanimous philanthropists.

THE anticipated settlement of the telephone trouble in Rochester, N. Y., again seems to be a thing of the future. At a meeting of the executive committee of the association of citizens on the 24th ult., a resolution was adopted to the effect that the committee will not designate any person or persons to become directors of the local telephone company. The report of the executive committee received the ratification of the association by its adoption as a whole. A resolution was also passed that no member of the association make a contract with the Bell Telephone company unless upon recommendation of the executive committee.

JUDGE GRESHAM has refused a motion for an injunction order in the case of the Western Union telegraph company against the Rock Island County Brush Electric Light company. The plaintiff corporation asked that an order issue restraining the defendant from maintaining its light wires in proximity to the defendant company's telegraph wires. The plaintiff alleged that a constant danger of fire existed when the wires were near each other. Judge Gresham ordered that incandescent lights instead of arc lights be used by the company until the suit could be settled on its merits.

EVEN an old operator must be impressed now and then at the marvels he can work with the telegraph. Recently an operator at San Francisco, Cal., called for Chicago, then secured Valentia, then London and finally Cairo, Egypt, and held a brief conversation. The Pacific speaking with the Nile across the North American continent under the Atlantic, the Bay of Biscay and the Mediterranean sea is a feat that would have surpassed the wildest dreams of those who witnessed the opening of the century and is calculated to even awake the astonishment of those familiar with the accomplishments of the telegraph of to-day.

FOR simplicity of expression and clearness of exposition of the general principles underlying the construction and operation of electric light installations, the chapters from "Dynamo Tenders Hand-Book" by Professor F. B. Badt, presented in this issue, are to be cordially commended.

We can state at the outset that to the deep student there will probably be but little in the portion of the book to be printed in these columns of interest; on the other hand we can state just as confidently that to the larger and increasing army of dynamo tenders and linemen, stationary and marine engineers and all others interested in electric light installations the book will be of the utmost interest and advantage.

Professor Badt, it is needless to add, is a man of wide experience and sound learning, and the book is the more valuable for having come from so eminent a source.

THE increasing interest developed in the instruments variously known as transformers, converters, or secondary generators, demands a full exposition of their merits and advantages, and it gives us pleasure to lay before our readers in this issue another portion of the able article on this subject by J. Kennett D. Mackenzie, the first part of which we gave last week.

Mr. Mackenzie reviews the early history of this invention which seems to have taken its origin from the well-known Ruhmkorff induction coil, and which is practically such a coil reversed, and variously modified. Passing from the early experiments he comes to the development of the system by M. Gaulard, now known as the Gaulard & Gibbs system, the discussion of which occupies the remainder of the installment given last week. In this week's installment he takes up the practical working out of a system of supply based on parallel transformers and its connection with the dynamo. The London *Electrical Review* commenting on this paper claims that it contains very grave theoretical errors but has a practical value in showing the workings of the system and the precautions required in carrying out its details.

THE congressional committee on post-offices which has had in charge the postal telegraph bills, has gathered a number of interesting facts in its investigations. The number of persons in the country who use the telegraph lines is, the committee estimates, about 3 per cent of the population. Of the messages, 85 per cent. are sent by bankers, board of trade men, stock dealers and newspapers. When all conditions are taken into account the cost of messages is much cheaper in this country than in Europe. Great Britain and Ireland, with an area of 121,112 square miles, have a population of about 36,000,000, all within an air-line distance from London of 500 square miles. To reach the same number of people in the United States it is necessary to include nearly all the country east of the Mississippi, covering an area of 861,102 square miles. The cost of messages of twenty-two words sent from London to the continent — a distance of 250 miles — is 88 cents to $1.32; for the same distance in the United States it is from 23 to 59 cents. A dispatch from Paris to a point 1,000 miles distant costs from $1.05 to $2.33. A message from New York to a point equally distant, costs from 59 to 90 cents. It is also found that in England, under government management, twice as many operators are employed to handle the same number of dispatches as are handled in this country by operators employed by a private company. The wages paid telegraph operators here are about double those paid in Great Britain.

IN this issue we conclude an interesting paper on electric engineering read by William Geipel before the London Institution of Civil Engineers. Mr. Geipel reviews the applications of electricity to motors, distribution of power, lighting and metallurgy, and refers especially to the great progress, recently made in the United States in the applications of the motor to industrial purposes, European science having supplied an agent the value of which has been recognized by American engineers.

As a means of transmitting power he shows its great superiority to belts and shafting, which often entails a loss of 25, 50, or even 99 per cent. of the power generated by steam or water. The distribution of energy from a central station by electricity for power and electric lighting he shows to be of the greatest economic importance for all purposes where cost and inconvenience practically exclude the steam engine, as for lathes, sewing machines, and other light machinery, requiring from a quarter to half a horse power, and for domestic and office lighting.

In the operation of electric tramways Mr. Geipel regards the use of electricity as eminently practicable, and for short lines more economical than any other method; the method by conductors being preferable to that by accumulators as at present developed. He also shows the economic advantages of telpherage.

In his review of electric lighting he takes up the important subject of transformers, showing the comparative advantages of the continuous current and alternate current transformers; refering also to the advantages expected to be derived from the use of secondary batteries in this connection.

Electric metallurgy he regards as very important especially in the separation of ores, which he reviews at considerable length; and closes with some pertinent remarks on aluminum and electric welding.

IN an editorial in the Chicago *Times* of recent date, in which the advantages of a cable line for the west side are pointed out, the following remarkable paragraph occurs:

"Here and there is found an advocate of the electric motor for street cars. These people, few in number as compared with those who prefer other systems, probably do not know that electricity, as applied to street railway uses, is in an undeveloped and experimental stage. In time it may be applicable, but that time has not yet come. If electricity as a motive power was ready to hand, it is not likely that the street car companies would be spending so many millions of dollars in the construction of the more expensive cable system."

The electric railway long ago passed the experimental stage. That improvements will make this mode of street car propulsion still more perfect, is to be expected and to be desired. There are at present, either already installed or in process of installation, between thirty-five and forty electric railroads in this country, and gentlemen who are in a position to know, confidently predict that before the close of the year, at least 100 railroads of this kind will be in operation. It is safe to assert that electricity can count a greater number of advocates than any other method of propulsion. When the comparison is made with the cable, electricity appears in a favorable light. It is more flexible than the cable system. The electric cars are independent. There is no possibility of a standstill of a whole line by the breaking of machinery. Electric machinery is sure, as is demonstrated in the case of those central stations which have been in operation for six years, and during the entire period the current has not been off the wires for an instant. If, in the paragraph quoted, the writer, in speaking of the experimental character of the electric railway, had reference to cost, there is an element of truth in the statement. It is true that the electric road of two years hence may cost considerably less than that of to-day, but how is it with the cable system? Not long ago the cost of constructing a mile of cable line was roughly estimated at $100,000, but only a day or two ago an offer to build a mile for $30,000 was made. Every cable system is experimental to a large extent. No two cable systems are constructed just alike. The north side cable in Chicago is still experimental, apparently, judging from the time required to put it into working order. There are difficulties yet to be solved before electrical railroads are practicable in a city like Chicago. If the law allowed overhead wires, the city would have been before this traversed by fully as many miles of electric roads as there are at present of cable lines. To-day, however, electricity is more popular than the cable, and more electric roads are building than cable lines. The number of electric roads in this country, at the present day in successful operation, exceeds the number of cable lines.

Electricity.[1]

By Geo. H. Bliss.

PART III.

If the atom is changed by abrasion, solidification or in its chemical structure, force must be given off or absorbed according to a fixed law. We have seen that various forms of energy may be converted into each other, and hence it is true that the earth is a great reservoir of force which may at any time, under favoring circumstances, appear as electricity.

We can not scuffle our feet over the carpet without exciting enough electricity to ignite the gas if the air is dry, and the cat's back can not be rubbed at all times with impunity.

If we are on the lookout for electricity we shall not be long in finding it.

Permit me to point out some of the ways in which electricity may be excited upon and in the earth. Suppose we take a short piece of small steel wire and fasten at the centre four short arms, there being at the end of each arm a small metal wing, one side of each wing being painted black and the other side remaining bright. Then we will suspend this wire in a glass bulb from which the air has been exhausted, and be careful to leave the wire free to revolve. By placing this little radiometer in the sunlight the difference of the force of the sun rays in striking upon the dark and white surfaces will cause the metal wings and wire to revolve slowly. Here we have the sun rays producing motion and we know that motion is easily converted into electricity. May it not be possible that it is the revolving power of the sun's rays which causes the earth to rotate on its axis? We have seen that heat is often converted into electricity. The sun is constantly pouring down upon the earth a vast store of energy in the shape of heat and light. It is probable that a portion of this energy is changed into electricity and that in this form the force is manifested to us. The continuous revolution of the earth in combination with varying temperatures, creates almost constant motion of the atmosphere. The friction between the air in motion and the more solid portions of the earth is great and we have seen that friction often generates electricity. We sometimes have magnetic storms from this cause when the ground is frozen and covered with dry snow, which insulates it from the atmospheric electricity. These storms occasionally interfere with the operation of the telegraph lines. The wires gather the electricity from the air, and if the polarity corresponds with the regular current the combined strength may be too great to permit the proper adjustment of the instruments. Sometimes the atmospheric electricity opposes the regular line current and nothing can be done while the storm lasts till poles of the batteries are reversed. There have been instances where telegraphic connection has been carried on by air currents alone, but as a rule atmospheric electricity is too fitful and intermittent for reliable results.

The speaker has had some practical experience of the electrical power which is sometimes developed in these winter storms. Several years ago I had occasion to put up a set of automatic repeating instruments at Cedar Rapids, Ia., on the first through telegraph line to the Pacific coast. It was in the winter and a violent snow storm was raging when the instruments and wires in the office were ready for use. While standing on a high stool and attempting to make a connection to the line at the top of a window, a violent electrical discharge seriously burned my right hand and hurled me to the floor. I have ever since been convinced that the so-called magnetic storms are entitled to careful and even respectful consideration.

In the extreme northern regions where the frozen condition of earth and sea makes an almost perfect insulation, the air occasionally becomes so electrified that the brilliant rays of the aurora borealis become visible to us in the northern skies.

Again, when the earth becomes heated by the hot summer sun the air takes up additional moisture. As this air rises and cools in the upper atmosphere the water becomes visible in the form of clouds. Under favoring circumstances the heat which is given off in the process of condensation becomes converted into electricity. This reveals itself in the flash from cloud to cloud and occasionally in the thunderbolt which dashes itself with enormous velocity and violence upon the earth

The internal heat of the earth must be a fruitful source of electricity, and is ample cause for the work which has evidently been done by electric currents in various portions of the earth's crust. The chemical action both in the interior and upon the surface of the earth is another good reason for the existence of electrical phenomena.

Now let us look at some of the conditions under which electricity can be utilized. It has a strong tendency towards wide distribution. This is especially favored by moisture, for any damp surface readily dissipates it. Once having reached the earth, it disappears by distribution, absorption or conversion into other forms of force. While no material is a perfect insulator there are substances such as glass, porcelain, gutta percha, rubber, cotton and silk, and numerous compounds thereof which resist the passage of electricity when the tension is not too great and enables us to confine it to iron and copper conductors so as to serve useful purposes. If a rifle bullet is tossed in the air it may be caught with safety or if a cannon ball is rolled it may be stopped with the foot, but when either is fired from a gun you get in the way at your peril.

The quantity of electricity in a lightning flash is often so small that a mark not larger than a pin head can hardly be found on the person slain by it, but the velocity of the bolt is inconceivably great and represented by thousands of volts. The nonsense of using glass insulators against lightning which can jump from the skies in connection with protection rods is perfectly apparent. The thing needed is plenty of copper in the rod and such a contact with damp ground as will ensure an easy pathway to the earth when the bolt falls. The speed of electricity as used for telegraphic purposes, although sufficient to transmit a signal 1,000 miles in the fraction of a second, is as much slower than a thunderbolt as the progress of a snail is to the speed of the locomotive. The electrical energy required to operate all the instruments on the longest telegraph line never exceeds one-twenty-fifth of a horse power. Such currents are easily generated and maintained by the ordinary galvanic batteries and glass insulators hold the electricity upon the wires securely. When ocean telegraphy came into vogue a new condition had to be provided for. On account of the great lengths of the cables it was at first supposed that enormous batteries were needed, and there is little doubt that the early cables were injured by the high tension currents sent over them, which destroyed the insulation. Experience taught the needful lesson that it was best to increase the sensitiveness of the receiving apparatus and decrease the battery. By suspending a magnetized needle with a delicate silken fibre over a small coil of wire attached to the cable, it was found that deflections of the needle could readily be produced with a few cells of battery. In fact intelligent signals have been received through the Atlantic cable from a battery made in a lady's thimble.

It would be interesting to pause to consider the methods by which messages are sent both ways at the same time over ocean cables and how four messages are constantly being sent over the many wires in the United States. Where a wire is used for four messages one circuit is considered actual and the other three are regarded as phantom wires. There are in daily use in this country more milesof phantom wire than there is of actual mileage; of course there are many routes where the business does not require to be quadruplexed or even duplexed. The saving of capital by such improvements is very large.

The telephone has become to many a sort of commonplace affair, but to me it continues a mystery. How all the vibrations of the voice are duplicated by such delicate electric currents and transmitted over miles of wire in intelligible speech is a matter for profound wonder.

But we have come upon an age when something more is demanded of a system of electrical distribution than carrying the small currents required for telephonic and telegraphic transmission. A single incandescent electric light requires more current than a telegraph line from Chicago to New York. There is a single Edison station now being erected in Chicago with the capacity of 30,000 lights and they will cover only a small area in the center of the city. Just think of the enormous conductors which would be needed to provide for the lighting of this entire city.

To be sure they could go under ground, but the cost in the present state of the art is prohibitory. There are probably one million incandescent electric lights burning in the United States to-day, but this is only a small fraction of the number to be put into operation under favoring circumstances. The individual incandescent lamp as now made burns with a pressure of about 110 volts which is a safety current to all who use it. With such a pressure on the wires the investment demanded in such an area as Hyde Park is too great for economic results. The development going on in connection with incandescent electric lighting appears to be in the direction of greatly increased pressure on the street wires with a corresponding reduction in their size. This makes it necessary to use apparatus known as converters to change the current before it enters the buildings from high to low pressure. Converters can not be used unless the dynamos are made to generate alternating instead of currents of constant polarity.

There is, however, no difficulty about sending alternate positive and negative impulses to the line and such currents appear to create light equally well with constant currents. The friends of the alternating high pressure system are claiming for it great results and a goodly number of installations, both in this country and in Europe, are being made so it can not be long before the practical results will be well understood.

Up to the present time Mr. Edison has strenuously opposed the alternating high pressure system, claiming that the increased danger from the circuits, the extra care and expenses needed to control and care for such high tension currents, the cost and loss in the converter, more than make up for the saving made in the conductors as between the high and low pressure systems. It is to be hoped that we shall not have to wait long in Hyde Park before incandescent lights will be available in our homes.

It is probably known to most of you that when a dynamo for generating electricity is introduced into an electric circuit the armature will commence to revolve and electricity will be converted back into power. Electric generators and motors are made upon the same general principles although they differ in details. Electric power is coming into quite general use. It is sold at about twice the price charged for steam power, but as in many cases the electric power is bought by meter measurement of the current and is therefore paid for only when used, it becomes in such a case both economical and convenient.

A single company recently received in one month orders for electric motors to the amount of over one-thousand horse power. There must be at the present time at least one hundred street railways using electric motors exclusively. It is destined in our own city to become a great factor, if not to supersede the costly cable system now in use. Electricity has already invaded to some extent our homes in the shape of electric bells, electric calls, electric alarms, electric heat regulation, electric lights, electric telephones and electric medical apparatus. Surely we ought not to be denied electric power to run the sewing machine, scour the tins, work the wash tub, wring the clothes, mix the bread and save such other arduous labor as will contribute to the peace of mind and comfort of the household.

Now that they are beginning to store electricity successfully and to carry it round in a cart, what is there to hinder us from having all we want of it? Mr. Edison at one time was so fortunate as to discover that under certain conditions electricity possessed a lubricating principle. Upon this discovery he built up an entirely new system of telephonic and telegraphic transmission. The Western Union Telegraph company not caring to be disturbed in certain rights which it thinks at least should be exclusive, purchased the inventions. I know that the one hundred thousand dollars which Mr. Edison received

[1] Read before the Hyde Park Lyceum, February 6th.

therefor had a very lubricating effect upon his feelings as well as his pocket book. Years before, when very poor, he went to New York with an invention which the officers of the telegraph company contemptuously rejected. He vowed then that the day should come when he would receive fair consideration and his conscience never felt perfectly easy on that score till this $100,000 check was paid to him.

It seems therefore that electricity in addition to its widely extended utility in the arts may become a panacea for wounded feelings as well. Let us indulge the desire that to every one present it may always be a source of pleasure and comfort and to the brotherhood and sisterhood of the world at large it may aid in rolling aside the burdens of life and hasten the incoming of the millennial day of perfect content and happiness.

(*Concluded.*)

The Book Table.

ELECTRICITY FOR PUBLIC SCHOOLS AND COLLEGES, by W. Larden, M. A., 475 pages, 12 mo., published by Longmans, Green & Co., London, 1887.

This book is well illustrated with cuts of medium quality, the paper and typography are fairly good, but might be improved. A student's eyes are his main reliance, and brevier type should be eliminated from all text-books, as the slight extra cost of a book is not to be compared with the permanent loss entailed by impaired sight.

The first three chapters, comprising 41 pages, describe the ordinary phenomena of magnetism, and the following seven, comprising 121 pages, treat of static electricity while the remaining fifteen chapters, 313 pages, are devoted to dynamic electricity and its applications.

In his treatment of static electricity the author is hampered with the complicated theory of two electricities, which rests as a constant incubus on all his reasoning and explanations. This theory is now about a hundred years old, was adopted as the best explanation of phenomena then very imperfectly understood, and has been accepted by many leading electricians since; but the time has come when the nature of electricity is far more perfectly understood, and it may be safely assumed that if the great electricians of the past had before them the experience of the present the dual theory would find but few advocates.

The author is not ready either to adopt or reject this theory, and the result is a doubtful, vacillating method of treatment, which leaves the student without any well defined, well supported view.

As instances of this we find on page 47 the statement that "what '+ and — electrifications' mean we do not yet know." On page 49, referring to the two theories, one electricity, or two electricities, he says: "The reader is again warned that in the present state of knowledge it is unadvisable to lay much stress on either view." And yet on page 70 we find him adopting the dual theory in the following language: "If two parts of the conductor be at different potentials then there is unlimited + electricity ready to flow from the higher level to the lower, and unlimited — electricity ready to flow from the lower to the higher level."

On page 92 we find him wrestling with the well known phenomenon of the card pierced by a Leyden jar discharge, leaving a burr on both sides, as follows: "The hole has been apparently formed by an explosion from the inside due to the sudden expansion of air or the sudden expansion of water." "The discharge may take place from + to — or from — to +, or may be a series of alternate discharges, or may be of some dual nature not represented by any of the above suppositions."

The problem has evidently "floored" him, and he gives it up in sheer despair. We submit that this is decidedly weak for an electrician of 1887, asuming to teach and explain electric phenomena to students in colleges.

He disposes of the very important subject of atmospheric electricity in the usual summary manner, giving it only one brief, eight page chapter.

On dynamic electricity the work is very full and thorough; every important point is fully discussed, and the dynamo, the motor, and the electric light receive an ample share of attention; so that the book in this department is fully up with the times, and will amply repay attentive study.

Prospects of Electricity as Applied to Engineering.

An abstract of the first installment of William Geipel's paper on this subject, before the Institution of Civil Engineers in London, was given in No. 9 of the WESTERN ELECTRICIAN; the second installment continues:

Storage batteries on the car have not yet been much used. The difficulty is that if the accumulators are made light their depreciation is high, while if they are constructed with a thoroughly serviceable make of cell their weight is very great. The first cost of the cells is also somewhat prohibitive and their depreciation high. With motors, speed reducing gear, and secondary batteries all improved, experiments now being made bid fair to demonstrate the successful working of tramways by electricity in crowded thoroughfares.

An electric tramway may be worked for about three pence per car mile, and as the cost of horses is from seven pence to nine pence per car mile the importance of electric propulsion for tramcars and short railways is very evident. Notwithstanding that the use of electricity for heavy railway traffic has been predicted, the author thought that, "so long as electricity is generated by steam engines, steam locomotives will not be discarded in favor of electricity for long distances; but for light railways and suburban lines underground or overhead, where the use of a steam engine is a nuisance, there can be little doubt that electricity must be largely adopted in the immediate future, as the number of such railways already constructed and in course of planning is now between one and two hundred.

"Where material has to be conveyed across hilly districts or over bad roads, to the railway or water, telpherage will be found useful. It has been successfully employed for the past two years at Glynde for transporting clay to the railway, over a distance of 1,600 yards; 270 tons are carried weekly at 7½ pence per ton. In our larger cities a modification of this plan might advantageously be applied to alleviate the heavy street traffic. In place of wire ropes stiff girders might be used, the cars being suspended from wheels running along a rail or rails fixed on the girder. Such a railway would be economically constructed, in comparison at least with the expense of constructing an underground railway; and it would not have any great effect in obstructing the light from the streets, as is the case with elevated roads for steam locomotives.

"Of the four branches of electric engineering dealt with in this paper, electric lighting is the one which up to the present has received most attention, called forth the largest outlay of capital, and produced the most beneficial results, if not to so great extent in this as in other countries.

"In incandescent lighting, the cost of distribution is still heavy, though by increasing the electromotive force and the efficiency of lamps it is being much reduced. In arc lighting, the difficulty of subdividing and of reducing the amount of light given by one arc lamp renders it expensive for general out-door street illumination, as compared with the present low prices of gas and oil. For the lighting of main streets and railway stations, or other places where a concentrated light is required, the arc light is beyond question far cheaper than gas; and its cost per candle power is but a very small fraction of that of gas. As the use of electric lighting extends, the cost of working becomes reduced; installations which four years ago cost four pence per arc lamp per hour are now costing only two pence. The chief saving has been in the items of carbons and attendance, though the increased efficiency and durability of the apparatus have also greatly contributed to the reduction; four years ago 11 mm. or .43 inch hard carbon cost four pence per foot; they now can be obtained for 1¼ pence per foot, or less than one-third.

"The cost of incandescent lighting is especially variable, and affected by the local conditions of the installation. The chief of these are the average number of hours of lighting each lamp, and the average distance of the lamps from the generating station. Where the conditions are favorable incandescent lighting can already compete with gas; and in a number of installations which have been superintended by the author a large saving is being effected. In the United States there is hardly a city or town of 20,000 inhabitants which has not a central station for arc or incandescent lamps; and many towns of 3,000 or 4,000 are supporting them also. On the continent large central stations for electric lighting are already in operation in competition with gas; but there the price of gas is generally two or three times what it is in this country.

"If the power is to be generated by dynamos and used direct, the cost of distribution on a large scale will probably never be reduced as low as with the existing gas supply, seeing that an efficiency of 95 per cent. can now be obtained with the dynamo, and that steam engines are not likely to be materially improved. It is therefore in the lamps that improvement is to be looked for, by making them with a higher resistance and greater efficiency.

"Transformers are at present receiving a large amount of attention. By their means small high tension currents of electricity, sent from a distant generating station along a small conductor with a comparatively small percentage of loss can then be converted into large low tension currents for the supply of ordinary incandescent lamps. In some of these transformers the loss in conversion is not more than 5 per cent. Unfortunately the alternating system, which has thus far been adopted, cannot be used with satisfaction for driving motors doing practical work or for charging storage batteries. The continuous current transformer has certainly the advantage in respect to the supply of power and to the charging of storage batteries; but it is a question whether the disadvantage of having to keep it continually in motion will enable it in town lighting to compete with the alternate current transformer. The latter is employed in the Grosvenor Gallery central station in London. Some idea of its importance may be formed from the fact that the Westinghouse company have already in America over 100,000 lamps at work on this system, although it is not yet two years since they adopted it. Notwithstanding that the use of transformers enables a great saving in copper to be effected, more especially where the lamps are scattered, as in suburban districts, yet it is to be remembered that the insulation of underground conductors forms a very important item in their total cost. The installations already at work are all worked with overhead conductors, with one exception at Eastbourne; so far as the author is aware, there are no practical data to establish the general applicability of the transformer system for the lighting of large and thickly populated towns where underground conductors may alone be tolerated.

"Secondary batteries charged in series by a high tension current and discharged in parallel have been tried experimentally, but their practical application is not known to the author. At the same time, now that transformers are becoming more used, strenuous efforts are being made to introduce this system of secondary batteries, and if it can once be demonstrated to be economical, there can be little doubt that it would have a large field of application. Its great merit is, of course, the reduction of risk of the light failing.

"It should be borne in mind by electric light companies that the supply of incandescent lamps is not to be their only source of revenue, but as already pointed out, the supply of current should be of such a nature that it may be employed for as many purposes as possible. By the use of efficient boilers and engines and properly constructed continuous current dynamos, a central station can be so constructed as to be no nuisance whatever, provided proper precaution be taken in selecting the site. In large towns it will not be necessary to extend the conductors very far before a demand will be met with sufficient for occupying an engine large enough to be economical. Above a certain size the cost of working a steam engine becomes practically constant for any increase in size; so that, instead of working from one large central station over a very large area, it is found better to work from smaller stations over smaller areas. The cost of attendance will thereby be increased to only a small extent, because one man cannot fire more than two boilers; therefore, when more

boilers are required, it is preferable to work them at another station with another fireman. At Leamington an extensive central station is now at work, and the cost of the undertaking is about £30,000. The Bradford corporation have recently voted a sum of £15,000 for erecting a central station in their town. Both of these are instances of direct supply, without transformers or secondary batteries.

"Electric metallurgy bids fair to become speedily of the highest interest to engineers. The electro-chemical separation of ores on a commercial scale by the electric furnace has but recently been put to the test, chiefly in obtaining aluminum from corundum, its richest ore. Sir William Siemens first turned his attention to the subject, but his death occurred before he had perfected his invention. It was taken up by Messrs. Cowles, who, with the assistance of Prof. Mabery, have devised a furnace, in which by the passage of powerful currents, the refractory ore is successfully reduced. The furnace is built of fire brick, and lined with powdered charcoal to withstand the intense heat. It is in the form of a box, 5 feet long, 12 inches wide, and 15 inches deep. Current is conducted through the walls and into the ore by means of a number of carbon rods 3 inches in diameter, and from 2 to 3 feet long. The positive and negative carbons are introduced from opposite ends, and nearly meet in the center. The ore, mixed with charcoal and granulated copper, is put in so as completely to surround and cover the carbon. The furnace thus charged is closed with a layer of charcoal and a lid lined with firebrick; without the protection of some such refractory material as charcoal, the intense heat causes the firebricks to run. When the furnace is ready, the current with an electromotive force of 50 volts is turned on, and is gradually increased up to some thousands of amperes. In a few minutes the metal is melted around the electrodes; and these are then moved farther apart, until the current passes through the entire charge, and the whole is in a molten condition; the corundum becomes gradually deoxidized, the aluminum combining with the copper, while the oxygen with the carbon escapes as carbonic oxide; about five hours suffice to complete the reduction. Current was supplied by large Brush dynamos, which were specially constructed for the work, and capable of giving out 300,000 watts, or over 400 electrical horse power. The weight is nearly 10 tons; 5,424 pounds of copper are wound on the field-magnets, while the armature has 825 pounds of copper on it. Works already in operation at Lockport, N. Y., have a capacity of 6,000 pounds per day, and the cost of the aluminum bronze so made is expected to be less than 1s. 8d. per pound, while Mr. Cowles anticipates the price being reduced to 8 pence per pound. Works have also been started at Stoke-on-Trent, where a 500 horse power dynamo has been fixed for generating the current; the potential is 60 volts.

"Another electric furnace has been devised by Dr. Kleiner, of Zurich, in which cryolite, a double fluroid of sodium and aluminum, is similarly treated.

"When it is remembered that the metal aluminum, in addition to many other good qualities, possesses great strength with only one-third the weight of iron, the importance of obtaining it at a reasonable cost will be readily appreciated; it would undoubtedly cause a great revolution in engineering construction.

"The process of welding by electricity, introduced by Prof. Elihu Thomson, is similarly based upon a passage of a powerful current between two electrodes. In this case the two pieces of metal to be welded form the electrodes; they are brought together into close contact, and as soon as the current is sent through the joint its resistance causes intense heat until the weld is perfectly completed. The process is almost instantaneous, and the heating occurs only at the joint; tempered steel can thus be welded without in the least affecting its hardness.

"Another plan of electric welding has been introduced at St. Petersburg by Dr. Benardos, in which the heat necessary for fusion is caused by an arc. The current is conducted to the weld by means of a carbon rod, which is connected by a flexible cable with the positive terminal of a dynamo or battery, while the metal to be welded is connected with the negative terminal. The action of the arc set up by the flow of current from the carbon to the metal may be likened to that of the blow-pipe flame, except that the heating is more intense and sudden, and is therefore more local. The reducing action brought to bear on the metal keeps it clean and unoxidized."

Lamp Lighting Schedule — Moonlight System.

MARCH.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**6.20**	**10.50**	4.30
2	**6.20**	**12.00**	5.40
3	**6.20**	1.10	6.50
4	**6.20**	2 20	8.00
5	**6.30**	3.20	8.50
6	**6.30**	4 10	9.40
7	**6 30**	5.00	10.30
8	**6.30**	5 20	10.50
9	**6.30**	5.20	10.50
10	**6.30**	5.20	10.50
11	**6.30**	5.20	10.50
12	**6.30**	5.10	10.40
13	**6.30**	5.10	10.40
14	**7.10**	5.10	10.00
15	**8.00**	5.10	9.10
16	**9.00**	5.10	8.10
17	**10.00**	5.10	7.10
18	**10.50**	5.00	6.10
19	**11.50**	5 00	5.10
20	12.40	5.00	4.20
21	1.30	5.00	3.30
22	2.20	5.00	2.40
23	3.00	5.00	2.00
24	3.50	5.00	1.10
25	No	light.	0.00
26	No	light.	0.00
27	No	light.	0.00
28	**6.50**	**8.30**	1.40
29	**6.50**	**9.40**	2.50
30	**6.50**	**10.50**	4 00
31	**6.50**	**12.00**	5.10
	Total number hours,		191.50

APRIL.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**6.50**	1.10	6.20
2	**7.00**	2.10	7.10
3	**7.00**	3.00	8 00
4	**7.00**	3.50	8.50
5	**7.00**	4.30	9.30
6	**7.00**	4.30	9.30
7	**7.00**	4.30	9.30
8	**7 00**	4.30	9.30
9	**7.00**	4.30	9.30
10	**7.00**	4 30	9.30
11	**7.00**	4.30	9.30
12	**7.10**	4.20	9.10
13	**7.50**	4.20	8.30
14	**8.50**	4 20	7.30
15	**9.40**	4.20	6.40
16	**10.40**	4.20	5.40
17	**11.30**	4 20	4.50
18	12.10	4.10	4.00
19	1.00	4 10	3.10
20	1.40	4.10	2.30
21	2 20	4.10	1.50
22	2.50	4.10	1.20
23	No	light.	0.00
24	No	light.	0 00
25	No	light.	0.00
26	**7.20**	**8.30**	1.10
27	**7.20**	**9.40**	2.20
28	**7.20**	**11.00**	3.40
29	**7.20**	**12.00**	4.40
30	**7.20**	**1.00**	5.40
	Total number hours,		169.30

The foregoing schedule is practically good for the United States.
The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.
The time for lighting or extinguishing is given for the day on which the night commences.
The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

New American Electric Dynamo.

James J. Wood, electrician of the American Electric Manufacturing company, New York, has recently constructed a dynamo that is well worthy of more than passing notice. The dynamo is designed to run 75 arc lamps. Its weight complete is 3,800 pounds. Of this 2,000 pounds is cast iron, 750 pounds is wrought iron, 150 pounds composition, and 900 pounds copper, 200 pounds of which latter is on the armature. At a speed of 875 revolutions per minute the dynamo requires 41 horse power to produce a current of 6.8 amperes at 4,100 volts, giving an output of 27,880 watts in the commercial circuit, or 37.3 electrical horse power and 90.9 per cent. of commercial efficiency. It need scarcely be added that this is a very high showing for electric arc light machinery. At a recent trial the dynamo was run on greatly varying loads, but without any change of speed. It was even overloaded by placing 95 lamps in circuit, without any apparent diminution in the brilliancy of the individual lamps, though, of course, they must have given less candle power than the 1,200 nominal for which the machine was constructed, 1,200 nominal candle power being the usual standard for street lighting. Mr. Wood, in order to illustrate the range of the machine's capacity, then directed his assistants to turn off the lights, 5 at a time, then 10 at a time, and then 25 at a time, until all save one were turned off. This was repeated several times — turning off and on — without any perceptible change of power of the single lamp that remained burning. The dynamo was then placed on a short circuit, or all lights off, without the slightest danger from overheating, there being little or no sparking at the commutator, so perfect was the operation of the regulator. The lights were then rapidly turned on, the regulator responding instantly as the number of lights as increased, until the load was again at a maximum. The experiment not only showed the vast capacity of the dynamo, but the completeness with which the lilliputian regulator held the giant under control, increasing or decreasing the power as the occasion called for it.

The dynamo will run from 1 to 85 lights on a short circuit, or, for commercial purposes, 75 arc lights of 1,200 nominal candle power in a circuit of number 6 copper wire, 35 miles in length.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 10. — It is a painful fact to record that W. W. Marks, superintendent of the Bishop Gutta-Percha company, died at his residence in New York yesterday after a short illness. He had been troubled with heart difficulty, and has not been seen in his office for the past two weeks, but the fatal termination of his illness was entirely unlooked for and the news of his death is shocking to his many friends. Mr. Marks was a veteran in the electrical business. A month ago your correspondent took pleasure in telling in the columns of the WESTERN ELECTRICIAN how, for forty consecutive years prior to the 5th of February, 1888, he had given his time and attention exclusively to the manufacture of gutta-percha for insulating and other purposes. His inventive genius and his earnest attention to his life work won for him deserved success, and his courteous bearing always commanded the respect of his competitors and the admiration of his associates. Funeral services will be held at his late residence, 318 East 72nd street, Monday evening, at 7.30. W. Walcott Marks, who has been assistant superintendent for several years, will succeed his father in charge of the factory of the Bishop Gutta-Percha company.

The assembly committee, which at an expense of $7,000 to the tax-payers, has been investigating the affairs of the telephone companies in the state, submitted a voluminous report on the 7th instant. Details are given of each company, showing the capitalization, cost of construction, operating expenses, net earnings and dividends paid. The total number of subscribers throughout the state, is 26,240. The total capital stock of the companies doing business in the state is $8,395,000; the total cost of construction $5,800,000, and the total net earnings for the past fiscal year, $1,028,233. The average capitalization per subscriber in New York state is $319.93, and throughout the United States, $351.00. The committee believes that the returns of the Metropolitan Telephone & Telegraph company are larger than they have a moral right to demand, and submit a bill making the charge in the city of New York, $6.50 per month, with an added mileage of $2.00 per month for all points exceeding half a mile from any one of its central offices. It is not expected that the bill will be voted upon this session.

Damage to the extent of about $40,000, but

fully covered by insurance, was done by fire to the factory of J. H. Bunnell & Co., on Monday the 5th inst. The blaze originated from the overturning of a pot of paraffine.

The Society of Medical Jurisprudence and State Medicine, which includes in its membership some of the most eminent physicians in New York and vicinity, listened night before last to a paper by Dr. W. A. Hammond on the "Superiority of hanging as a method of execution." The argument was advanced that hanging causes an absolutely painless death. After considerable discussion a resolution protesting against the substitution of electricity for hanging was adopted, there being only one dissenting vote.

The New York Insulated Wire company are introducing a new splicing compound, for making moisture-proof joints, and Mr. Godfrey states that the sales are already very large and indicate an enormous demand for such an article. The special advantage of this compound is that no heat is required, the simple winding with tape completing the operation and making a perfect insulation. A.

From the Pacific Slope.

San Francisco, March 4.—Joseph Wilson has brought suit against the Western Union Telegraph company to obtain $50,000 damages In 1885, while he was riding between Yreka and Fort Jones, his horse stumbled on a detached wire and he was thrown from the animal's back, he alleges, sustaining injuries which have incapacitated him for active work.

The announcement that $25,000 was to be expended for an electric light plant for Baldwin's hotel and theater has excited considerable competition. Gentlemen representing different systems have come to the city from all directions.

Edward J. Walsh, electrician of the California Electric Light works of this city, committed suicide by shooting himself February 9th. He formerly resided in Boston.

J. D. Bishop, formerly torpedo constructor at the Imperial arsenal at Kian Chung Mow, is now a resident of this city. While in China Mr. Bishop introduced considerable electric machinery of American manufacture. He has constructed an electric meter which has a pendulum working between two pairs of electro-magnets. The meter has a dial similar to that of a gas meter. When the lights are not burning the pendulum is at rest. Mr. Bishop expects to go east soon to place the meter on the market.

The ferry boat Piedmont is being equipped with incandescent lights by the Central Pacific railroad company.

The Pacific Motor company of this city has 700 motors now in use and is employing five circuits.

W. W. Slatter, electrician and superintendent of the Central Pacific electric block system, is replacing all oil lamp signals by Swan incandescent lamps on an arc circuit. There are forty trains daily running over this block after dark and the greatest care is taken to keep all the colored lamps lighted to prevent accidents. It was very difficult to accomplish this when a strong wind was blowing. The change to the electric lights makes unnecessary the service of two men to clean lamps daily.

The city council of San Diego, has passed an ordinance providing that hereafter all electric companies desiring to operate in the city must put their wires underground.

An iron tower 125 feet high which the Jenney force was erecting at Berkely, fell last week. Two men were injured.

An action to obtain $7,500 has been brought against the San Diego Telephone company by Edward E. Dodge. The plaintiff alleges that while driving in his buggy a telephone wire became entangled on the wheels. The horse ran away and the plaintiff was badly injured.

The mine of the Oregon Improvement company at Franklin, W. T., is now lighted by incandescent lights. The mine is continually filled with gas and by the use of the electric light the company hopes to avoid the explosions which in neighboring mines nearly 200 deaths last year.

The state prison jute mills, at St. Quinten, are to be lighted by electric light. The use of gas would involve the danger of setting fire to the jute.

A motor system is being installed at Portland, Ore.

The majority of the small towns in Washington Territory, Oregon, and other northwestern states are supplied with incandescent lights Seattle, which has a population of 25,000 has two electric light companies. The places are ahead of California towns. S.

Detroit's Budget.

Detroit, March 10.—The special committee appointed some time ago to look into the question of public lighting in other cities, and the relative cost and efficiency of the same as compared with Detroit, submitted a portion of their report Friday last. The following statistics were presented: In the 121 cities the report covers, it is shown, that 37 per cent. are lighted by the Thomson-Houston system, 23 per cent. by the Brush, and the remainder by other systems. Forty-seven per cent. of the cities string their lights at street intersections, 39 per cent. place them on poles, 10 per cent. use towers and intersections combined, 3 per cent. use towers and poles combined, and but one uses towers exclusively. Forty-five per cent. have annual contracts, 6 per cent. have two-year contracts, 22 per cent. have three-year contracts, 19 per cent. have five year contracts, and 7 per cent. have no contracts at all. One city has a contract which runs for 10 years and one other is bound for 20 years. The cost of lighting the present system in Detroit reaches $188 per lamp per year, and for all new tower lights $219 each per year. The price paid by other cities range from $40 to $366. There are sixty different prices between these figures. The average cost in the United States of public lighting by contract is $141 per light per year. The average price in cities which own and operate their plant is $59.38. Sixty cities in the contract list pay above the average. Only eight are paying more than Detroit will pay for her new tower lights, and 23 pay more than Detroit pays for her present system. Ninety-eight do not pay as much as Detroit does for her present system, and 108 do not pay as much as she will pay for her new tower lights. Five pay the same.

The American Bell Telephone company has begun suit against the following users of Cushman instruments. Vernon E. Rix, *et al.* Charles Kelley, Charles R. Henry, Willard A. Green, Henry Boutyette, James E. Forrest, Caspar M. Zengerle, William V. Penoyar *et al.* Charles E. Wilcox, all of Au Sable; Albert H. Fish, Charles V. Hicks, George Orth, John V. White, David H. Weir, all of Oscoda.

The output of copper from Lake Superior mines for February was as follows:

	TONS.	LBS.
Calumet and Hecla	1,829	1,994
Tamarack	610	730
Atlantic	238	1,260
Osceola	203	
Franklin	170	590
Huron	116	200
Quincy	350	1,395

C.

From Kansas City.

Kansas City, March 10.—L. H. Holmes, manager of the Electric Time company, reports that the Warner station system of electric time is giving great satisfaction to them and to their subscribers in this city. The switch-board, which is the patent of the Standard Electric Time company, of New Haven, is the principal feature. The city is divided into ten circuits entirely independent of each other. Electric current is sent from the main regulator by means of relays through all the circuits simultaneously once each minute, causing the hands of each clock to advance just one minute by a sudden jump. The switch-board contains one small dial or indicator for each circuit, which, of course, stops when for any cause that line is broken. In addition to this, an electric bell gives a loud alarm for a broken line and, also, a fainter one for a case of low battery. Warner's electric gauge is set on the switch-board and can be cut into each circuit to show exactly the strength of current on the line. Broken lines are thus quickly located and low battery easily and surely guarded against. The board contains a system of switches and grounds by which a break is located in a half circuit and the other half at one set in motion. A test battery is then placed on the broken half and the break is found and repaired. Then the other half of the clocks are all set up to correct time from the central station, which is located in the jewelry store of Cady & Olmsted. The movement of the clock, which is also a Warner patent, is very simple and easy of action and has the advantage that it is not affected by a lightning stroke on the line. The company is placing a large number of clocks in the city.

The Home Telegraph and Signal company is about to extend its business by running residence circuits on which will be placed the Field & Firman "11 Call" boxes. Prominent among the eleven calls will be found the following: Police, carriage, coupe, fire, messenger. This will add greatly to the protection of the city.

The plant at Harrington, Kansas, which was installed by the Thomson & Houston company, has just been started and is giving good satisfaction. The machines installed are one arc dynamo of 30 light capacity, two incandescent dynamos of 200 lights capacity. The plant is owned and controlled by the Harrington Electric Light and Water Works company.

The combination arc and incandescent plant of 50 arc light capacity, installed by the Thomson & Houston company at Council Grove, has just been started and is giving good satisfaction. D.

Electric Motors in St. Louis.

St. Louis, March 10.—The electric motor car on the Lindell railway has commended itself to the officials of the road. The car has overcome all the obstacles. Mud has had no effect on the car, although there has been enough of it on the track to give a thorough test. Two new cars for the road are almost completed. John Scullin, president of the Union depot railway company, expects soon to contract for street car motors for his road. The St. Louis car company has completed seven cars for the Wheeling & Benwood railway company, all of them equipped with the Van Depoele electric motor. The road on which they are to be used is five miles in length. A new style of electric car is that of the L. M. Hodgeman. The motive power, according to his plan, will be furnished from a dynamo and batteries on the car, and can be applied to a single car or can be applied to a separate motor. Manager Christian Peper, of the street railway company, says that the electric motor has superseded the cable. The people, he said, a short time ago were demanding a cable road. Now, he says, there is a demand for the electric motor.

The St. Louis Cable and Western railroad was not in operation one day last month, and no little complaint was found by the public. D.

Carroll, Ia., Light Plant.

Carroll, Ia., March 10.—Carroll would have a first rate electric light plant were it not for the fact that the power has been insufficient to run the dynamo properly. A plan for interesting a number of gentlemen in the business has been formed, and in probability a good service will be provided. A new dynamo, with a capacity of supplying current for 25 arc lights, will be put in. D.

THE ELECTRIC LIGHT.

In the Court theater at Vienna scene painting is now done by electric light to secure the artistic effect of the colors, the current being supplied by Farbaky & Schenek accumulators, which are said to have proved very satisfactory.

The central distributing station recent installed by the Edison company at Nancy, France, is pronounced a complete success, the working of the Zipernowski transformers being very satisfactory.

At a meeting of the stockholders of the St. Joseph, Mo., Electric Light and Power company, the following directors were elected: A. N. Cluster, R. E. Turner, I. T. Hosea, J. S. Logan and J. A. Corby. The company will install one of the finest plants in the west. They will begin about April 1st to erect on their property, corner of Fourth and Mitchell avenue, a building two stories, eighty by one hundred and twenty. They propose using the alternating system.

Messrs. Walker & Oliver, of Cardiff, are introducing the Sunbeam incandescent lamp into South Wales, and have it already at work in several collieries. This lamp is a large glow lamp, in which a carbon thread takes the place of the thin filament used in the small lamps. As the lamp is made to give from 200 to 1500 candle power, it is intended to take the place of the arc lamp.

A portable electric reading lamp, fitted with a Schanschieff battery, has been presented to the Princess Christian. It is inclosed in a rosewood case inlaid with ivory, and is described as a model of neatness and simplicity, free from gas, smell or risk of accident, without wires, easily charged, and having a ratchet apparatus by which the lights can be regulated from one to ten candle power, and lighted or extinguished as desired.

According to the *La Lumière Electrique* the French patent for the Cruto incandescence lamp has been purchased by the firm of Rothschild.

A lineman, an employee of the California Electric Light company of San Francisco, met with an accident recently which nearly caused his death. His clothing was wet from the rain when he started to put in new carbons in an arc lamp. As soon as his pincers touched the screw he was thrown to the ground. When he was picked up he was unconscious and his body was rigid and to all appearances he was dead. Prompt measures at the hospital restored him.

H. A. Kinney gave an interesting lecture on modern electricity before the Y. M. C. A. at Omaha last Saturday. He explained in a popular way the methods employed in electric lighting and in furnishing power. The experiment which interested his hearers most, especially the ladies was the application of a motor to a sewing machine. One of his prettiest experiments was in lighting a bouquet of flowers by means of small incandescent lamps arranged among the flowers.

THE ELECTRIC MOTOR.

An exhibition of motors and their adjuncts will be given at Munich in August next, the special object of which is to show the advantages of small motors and their application for various handicrafts. No heavy machinery will be used.

The *Manufacturers Gazette* makes this prophecy: "The electric motor will in future take the place of long belts and lines of shafting. With a motor beside each machine, shafting will be cut up into truss rods and welded up into shapes for altogether different purposes."

On the tram line in the gardens of the Brussels Exhibition, says *Industries*, mechanical traction will be employed, the system adopted being that of Charles Legrand, of Mons. In the buildings and annexes, cars of the type known as Jardin d' Acclimation, in which the passengers sit back to back, will be used. The weight of this car, including eleven passengers, is 33 hundred-weight. The accumulators weigh 6 hundred weight, and the motor and gearing about 5 hundred weight. For these small cars, which will travel at the rate of about 4½ miles an hour, the energy required is estimated at 800 watts, or slightly over 1 horse power. For the convenience of changing the cells the latter are arranged in four groups, which are inserted and withdrawn from the ends of the car. There will be forty cells, each weighing complete 16½ pounds, and containing 13 pounds of plates. The maximum discharge current is 10 amperes, or about three-quarters of an ampere for every pound of lead. The speed will be regulated by changing the grouping of accumulators so as to obtain either 20, 40, 60, or 80 volts. The type of the accumulator chosen is that of Somzée; the motor will be either a Mourlon, Pieper, or Dulait machine. M. Halot will supply the track and car.

THE TELEPHONE.

The officials of the postal and telegraph department of the French government have reported in favor of operating the telephone by the government, and Messrs. Lair and May, president and vice-president of the Société Générale des Téléphones have been invited by the department to take cognizance of the matter.

The German railways use the telephone extensively for local service on branch lines. It is also used on some of the main lines in connection with the telegraph. Twenty-three companies employ it over a total distance of 28,436 kilometers.

At the Ventnor hospital on the Isle of Wight, the telephone has been adopted for intercommunication between the different departments, which are detached and cover an area a of quarter of a mile in length. An instrument is placed in each of the ten departments, and one in the lodge, all connected with the central switch-board in the chief nurse's room. Arrangements have also been made for extending the system so as to connect with the residences of the medical staff in the town, if it should be thought advisable in the future.

The telephone of Messrs. Mourlon of Brussels has been adopted by a company recently organized at Rosarrio, with a concession for the Argentine Republic and Uraguay.

A bright witted girl in Manchester, England, telephoned to her father at his office, asking if her dog, "Curly," was there. He replied that he was. "Well, take him up in your arms and hold the receiver to his ear; I want to tell him to come home," said the girl. Her father did so. The dog's countenance wore, momentarily, a look of astonishment at hearing "Come home, Curly! Come home!" in the feminine tones of his mistress, but it took him only an instant to understand what was wanted, and he made a break for home as fast as he could go.

The guardian of Elvenia Eliza Graves has begun suit against the Bell Telephone company of Buffalo to obtain $10,000. About a year ago Miss Graves was struck on the shoulder by a pair of pliers which fell from the hands of a lineman in the company's employ, who was repairing a break in the wire at Rochester.

The Great Southern Telephone company has finished its main line from Sun Flower Landing to Eagle Lake, Miss, a distance of nearly 200 miles. A large number of towns in the Mississippi delta are thus enabled to communicate which hitherto have been obliged to depend upon the slow and unreliable river mail service.

The Elgin Telephone and Electric Supply company has been organized, with a capital of $30,000. The incorporators are A. B. Church, W. Hubbard, Royal Kimball and A. D. Sill. The company has formed a new plan of electric lighting, and which promises to be successful. Electrical supplies will be handled. They will also establish a new telephone exchange, and will use the Cushman telephone and Hubbard's telephone for short distances, making connections with other cities, as now. The telephones will be sold outright.

In Spain telephone systems are being adopted rapidly by the principal towns, and offers are now invited by the government for an exchange station at Cordova.

"A short time ago," said a gentleman, "I had occasion to go to the mining district in West Virginia. I happened, in conversation with a man connected with one of the mines, to refer to the telephone. He asked me what I was, saying that he had never heard of it before. When I told him he smiled at me pityingly, as if I was insane or was engaged in a fruitless attempt to impose on him. I tell you that the stories that the people in that section of the country are a quarter of a century behind the times and that they don't know the war is ended, are not so very much exaggerated after all."

The telephone has been successfully employed to add to the comfort of persons who have contracted contagious diseases and are kept away from their friends. A telephone is placed near the bedside and the patient can talk to his acquaintances at will. The fact that the sick person is able in this way to enjoy companionship and is not obliged to feel that he is shut out from the world, contributes materially in some cases to the recovery of the patient.

At a recent camp fire of the Grand Army in Portland, Me., the venerable ex-Vice President Hannibal Hamlin was one of the speakers. His address was an easy, off-hand talk, mainly upon the progress and great developments in science and the arts that characterize the present century. In the course of it he said, speaking of the telephone: "And yet, perhaps more marvelous than all is that little instrument which puts us in communication with those we love a hundred miles away. My wife and your wives have tongues, as it were, a hundred miles long, and if by that little thing of a telephone I were in communication with my good wife at the present moment, I should hear her saying: 'Hannibal, be careful and not catch cold.'" An hour or so after this, when the memory of Mr. Hamlin's address had been partly obliterated by speakers who had followed him, Past Commander Sawyer rapped for order, and announced a telephone message from Bangor. All eyes turned in the direction of the venerable Bangor statesman where he sat surrounded by a bevy of young ladies who were importuning him for autographs. Mr. Sawyer continuing said: "Ladies and gentlemen, we have received a telephone message from Bangor. It says: 'Hannibal don't flirt with the girls.'" The applause that followed drowned reply.

The young man had been trying to tell her how madly he loved her for over an hour, but couldn't pluck up the courage. "Excuse me a moment, Mr. Featherly," she said, "I think I hear a ring at the telephone." And in her queenly way she swept into an adjoining room. Presently she returned and then his mad passion found a voice. "I am sorry, Mr. Featherly," she said, "to cause you pain, but I am already engaged. Mr. Sampson learning that you were here, has urged his suit through the telephone."

THE TELEGRAPH.

The Dominion parliament at Ottawa last week refused to entertain a motion for the appointment of a select committee to consider the advisability of the purchase of the telegraph lines by the government.

The capacity of the wires which can be employed in sending east the news of the democratic convention at San Francisco, is 22,000 words per hour. Seventeen wires can be employed.

The receipts for cable messages sent from Chicago telegraph offices aggregate, it is said, about $20,000 per month. Almost the entire amount is paid by twenty-five firms and a few banks.

It is asserted that monkeys interfere to a considerable extent with telegraph wires which pass through the jungles of Tobasco in Mexico. When several scores of these gymnasts give an exhibition on a tight wire it is liable to pull the cross arms from their position.

The Toledo, O., produce exchange has passed a resolution condemning the present telegraphic system. It seeks the coöperation of the Peoria, Ill., board of trade in a memorial asking congress to establish government telegraphy.

It is estimated that fourteen million more messages were sent in the ten principal European states in 1887 than in the previous year.

The first telegraph line in Belgium was established in 1846 by a private firm. At the end of 1853, there were in Belgium 406 miles of line, comprising a total of 1,350 miles of wire, and forty-two telegraph offices; while 52,050 telegrams were transmitted in the course of the year. Since that period the whole country has been covered with a network of wires, the number of offices open has risen to 870, and the annual number of telegrams to over 4,000,000.

Judge Matthews of the United States Supreme court has recently handed down a decision in the case of the suit brought by G. F. Hall & Bros. against the Western Union to recover $1,800. The plaintiffs whose residence is in Des Moines, Ia., telegraphed to Charles T. Hall of Oil City, instructing him to purchase 10,000 barrels of petroleum. Through negligence the message was not delivered until the exchange had closed, and the order consequently was not executed. Oil advanced 18 cents per barrel on the following day, so if the oil had been bought and sold the plaintiffs would have been $1,800 richer. The court holds that the only theory on which the plaintiffs could show damage is on the supposition that if they had purchased on the day on which they sent the order, they would have sold on the following day. It is clear, the judge holds, that no actual damage had been sustained. No

transaction was made and as there was no purchase or sale there was no difference between the sums paid out and the amount received which could be called a loss. There was nothing to show that the plaintiffs would sell at a certain time, consequently the only amount they are entitled to receive is the sum actually paid for sending the delayed message.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	350	360
Central Union	46	47
Michigan	76	77
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	68	69

Personal Paragraphs.

Cornelius Herz, editor of the able French electrical journal *La Lumiere Electrique* has been obliged to leave France. It is to be trusted that his exile will be only temporary and that the journal over which he has presided with such ability will lose nothing of its prestige.

We learn with deep regret that Lucien Gaulard, well known in connection with his work on secondary transformers, has become deranged.

Miscellaneous Notes.

An Ohio prison officer, who was interviewed on the question of inflicting the death penalty by means of an electric current said "I don't believe in making executions any easier than they are now, unless murderers can be induced to make death a little easier for their victims."

A Baltimore company proposes to sharpen the shoes of car horses in icy weather by means of electricity, without removing them from the stable.

If reports are correct the French syndicate controls the entire Lake Superior copper product. The president of the Osceola mine announced after the annual meeting in Boston last week that his company had sold its produce to the syndicate for the next three years. It is said that the Franklin, Huron, Quincy and Atlantic companies are on the point of making contracts with the syndicate if they have not already done so.

It is understood, says the St. Louis *Post Dispatch*, that a movement is on foot among the railroads centering in this city to place the watches of their conductors under the supervision of Prof. H. S. Pritchett's time-service corps at Washington University. On the strength of this, a New England watch manufacturing firm, which claims to have obtained the control of the anti-magnetic escapement idea, has sent an agent to St. Louis, supplied with movements whose feature is the palladium balance-wheel, hair-spring and anchor, and if the patent is demonstrated to be a success, the chances are that it will be adopted and that the University will in the near future be responsible for the accurate time kept by the watches of conductors on St. Louis railroad trains.

Mr. Edison will have nothing to do with inventions for execution by electricity. He is reported to have said, "I am a humanitarian and a supporter of the abolition of capital punishment, accordingly rather than countenance such inventions, which I hold in detestation, I should be tempted to study the means of restoring to life by electricity, the victim of capital punishment."

Among recently incorporated companies is the West Chicago Rapid Transit company, with a capital stock of $6,000,000. The purpose of the organization is to construct, maintain, lease, acquire and operate elevated railways in Chicago, on Lake, Randolph and Van Buren streets, from the lake the entire length west on those streets. It also contemplates build on Milwaukee, Ogden and Blue Island avenues, Halsted street, and other parallel and cross streets. The incorporators are all well-known west side citizens, being John D. Jennings, E. Nelson Blake, and Abner M. Wright.

Some interesting experiments on the reciprocal influence of organs of sense have been recently made by Herr Urbanschitsch, of Vienna. His general conclusion, says *Nature*, is that any sense excitation has for result the increase of the acuteness of other senses. Thus, sensations of hearing sharpen the visual perceptions. If colored plates are placed at such a distance that one can hardly distinguish the colors, and various sounds are then produced, the colors become generally more distinct the higher the sounds. Similarly, one can, while a sound affects the ear, read words which one could not read before. Again the ticking of a watch is better heard when the eyes are open than when they are closed. Red and green increase auditive perceptions; but blue and yellow weaken them. Several musicians, however, were agreed that red, green, yellow and blue caused an intensification of sound about one-eighth, while violet had a weakening effect. Taste, smell and touch are under like laws. Light and red and green color increase their delicacy, while darkness, blue and yellow diminish it. Under the influence of red and green, taste extends from the anterior border of the tongue to the whole surface. On the other hand a strengthening of smell, taste or touch exalts the other sensitive perceptions. Specially interesting is the reciprocal influence of touch and the sense of temperature. If one tickle the skin with a hair and plunge the hand into hot water the tickling sensation ceases; on the contrary, if the hand be placed in cold water and a part of the body tickled the temperature is felt more vividly. Herr Urbanschitsch finds in this reciprocal action an explanation of supposed double consecutive sensations on excitation of one sense.

When they execute persons by electricity, a man must be careful that he doesn't convey a wrong impression when he says his brother, father or uncle met his death by lightning.

A series of experiments is now in progress at the electro-technical institute of Vienna for determining the comparative merits of the accumulators of Julien, Reckenzaun, Farbaky and Schenek.

Business Mention.

The Helena Electric Supply company has been organized at Helena, Mon., by J. A. Williams. Electrical supplies and appliances will be kept in stock.

The Standard Underground Cable company, of Pittsburg, Pa., have just issued a new price list of electric light cables and insulated wires. In addition to containing general information regarding prices and sizes, the price list is rendered more valuable for special features; for instance, in the list on the wire known as number 1 standard weather-proof, the approximate weight per 1,000 feet per pound and the approximate number of feet to the pound are shown in adjoining columns; while in the list on electric light cables the number B. & S. gauge is shown; then comes the diameter of the solid copper wire in mils., their area in circular mils, then the nearest approximate number Birmingham gauge; following that the approximate weight in ounces per foot of cable, and then the approximate diameter of cable in mils. The new list is valuable to every electric light company.

Electrical Patents.

Issued March 6, 1888.

378,864. Apparatus for the propulsion of cars by electrical energy. Alexander H. Bauer, Boston, Mass.

378,876. Electric Ship Signal. John W. Dooley, Wyoming, Ill.

378,892. Magneto-Electric Machine. Osborn P. Loomis, Somerville, Mass.

378,913. Supporting Crane for Electric Lamps. Leander J. Wing, Lexington, Mass.

378,927. Police, Fire, and District Telegraph. Edward T. Gibson, Minneapolis, Minn.

378,943. Carbon Battery. George E. Terrell, Ansonia, Conn.

378,971. Insulator. Lewis M. Neal, North Middletown, Ky.

378,980. Electric Railway Car Brake. Wm. M. Schlesinger, Philadelphia, Pa.

378,983. Fire Alarm Signal Box. Alson A. Smith, Newton, Mass.

The device insures the non-interference of signals from different boxes, and can be applied to old boxes. Claim 3 reads, "The combination of the break-wheel of a fire-alarm signal box and a controlling electro- magnet and armature, with a shunt circuit around the break-wheel and magnet, and a circuit-closer therein controlled by the armature of said magnet, and a device controlled by the door of the box for mechanically operating the said circuit-closer."

379,016. Electric Telegraph. David Kunhardt, Aachen, Prussia, Germany.

379,037. Dynamo Electric Machine. Oscar Urban and Merle J. Wightman, Hartford, Conn.

The object of the invention is to avoid overheating. It consists in providing the core of the armature, which may be made up in ring sections, with open end-sections, so as to afford communication between longtudinal air spaces left between the coils at the ends of the armature and the hollow interior of the core. Claim 1 follows: "A rotary armature of cylindrical or other shape having open ends and longitudinal air spaces between the coils at the ends."

379,060. Telegraph Instrument. Emery M. Hamilton, New York, N. Y.

379,061. Telegraph Sounder. Emery M. Hamilton, New York, N. Y.

379,062. Pole Changer. Emery M. Hamilton, New York, N. Y.

379,063. Telegraph Key. Emery M. Hamilton, New York, N. Y.

379,064. Telegraph Sounder. Emery M. Hamilton, New York. N. Y.

379,069. Electric Railway. William W. Hopkins, St. Louis, Mo.

379,070. Electric Railway. William W. Hopkins, St. Louis, Mo.

379,073. Continuous and Alternating Transformer. Francis Jehl, Paris, France.

If the line carries an alternating current, this is simply passed through the primary coils, and an alternating induced current is taken off from the secondary coils, and used to feed a local or consumption circuit. If the line current is continuous, a commutator is necessary, in order to alternate it in the coils. Of the nine claims we give the first and sixth: "1. A transformer consisting of two cores wound with primary and secondary coils of wire, and arranged in such close inductive proximity that the lines of magnetic force in each core may be completed through the other core.

"6. A transformer having two stationary iron cores arranged in close inductive proximity and wound with primary and secondary coils divided into sections, in combination with a rotary distribution-commutator in connection with the sections of the primary coil."

379,074. Electrical Contact Maker and Breaker. Carvosso Lambdin, Barranquilla, United States of Colombia.

The device consists of a sealed inclosing case, preferably of glass, in the walls of which contact pieces are fixed, and a relatively movable conductor within the case capable of making connection between the said contacts or a selected number of them. The last of the three claims follows: "The combination, with a pivoted telephone-support, of a telephone supported on one side of the pivot, and a sealed chamber, carrying circuit terminals, and a movable conductor or connector supported on the opposite end of the support."

379,081. Spring Jack for Electric Railways. Sidney H. Short, Denver, Col.

The invention is adapted to electrically connect the ends of the sectional conductor, and to permit the passage of the current collector, so as to deliver through the same the necessary amount of electricity to drive the car. Claim 8 runs: "In an electrical railway, a spring-jack between the sections of the conductor, consisting of opposing faces normally in contact, one movable and the other fixed, and arranged to be separated by the passage of the current collector between the opposing faces"

379,082. Slot Switch for Electrical and Cable Railways. Sidney H. Short, Denver, Col

379,144. Burglar alarm. Charles H. Wright, Chicago, Ill.

379,180. Depolarizing Compound. August F. W. Partz, Philadelphia Pa. Claims 1 and 3 are given:

"1. The solid depolarizing compound herein described, consisting of chromic acid, sulphuric acid, and only so much acid sulphate of potash as is due to the action of sulphuric acid upon the bichromate of potash employed, said compound being practically free from chromic oxide.

"3. The process of producing a solid depolarizing compound, consisting, first, in reducing the bichromate of potash to a powdery state by fusion and cooling, and then decomposing the powdered mass by sulphuric acid.

379,201. Temperature Regulating System. Warren S. Johnson, Milwaukee, Wis.

The invention relates to the automatic supply and regulation of heat to apartments by a system of apparatus in which electricity controls a fluid under pressure and the fluid under pressure operates the controlling valves of the heating apparatus.

379,203. Telegraphic Repeater. Joseph Koelzer, Duisburg, Prussia, Germany.

10,907. Re-issue. Electrical Apparatus for Dental Operations. Chas. A. Eisenhart, York, Pa.

In use the patient grasps the dischargers or electrodes, and when the dentist is ready to operate he closes the primary circuit with his hand or foot. The high tension current passing through the muscles of the arms and body, acts to deaden the pain of the tooth nerves. The first claim reads: "In a dental electric apparatus, the combination of an induction coil, a regulator for varying the induced current, a circuit closer in the primary circuit, a controlling device for operating the circuit closer and regulator coincidently, an electric generator in the primary circuit and suitable dischargers at the secondary terminals."

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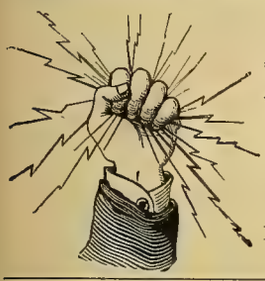

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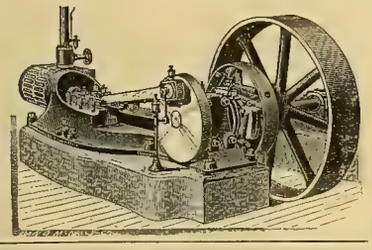

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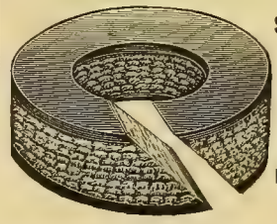

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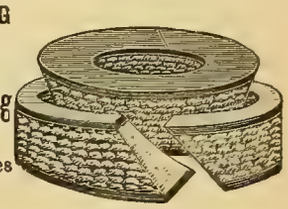

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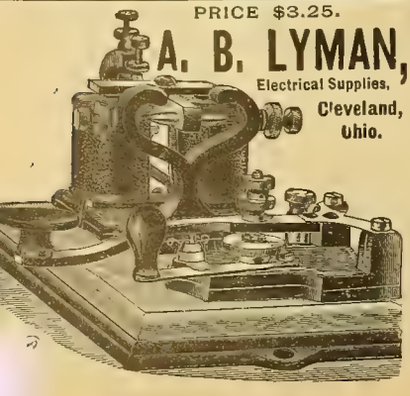

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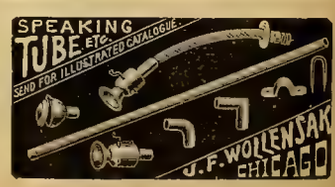

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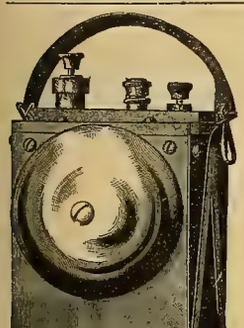

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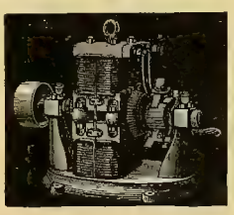

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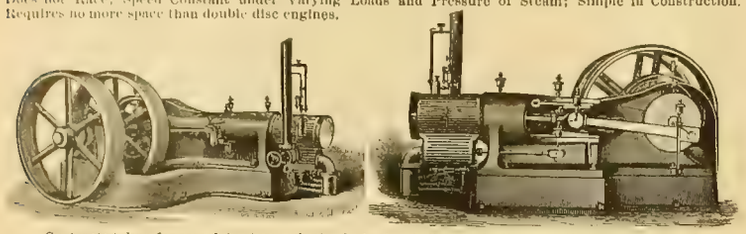

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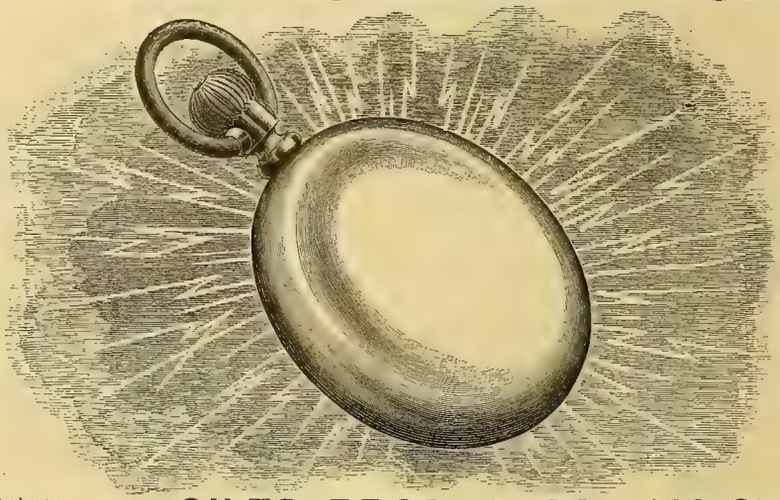

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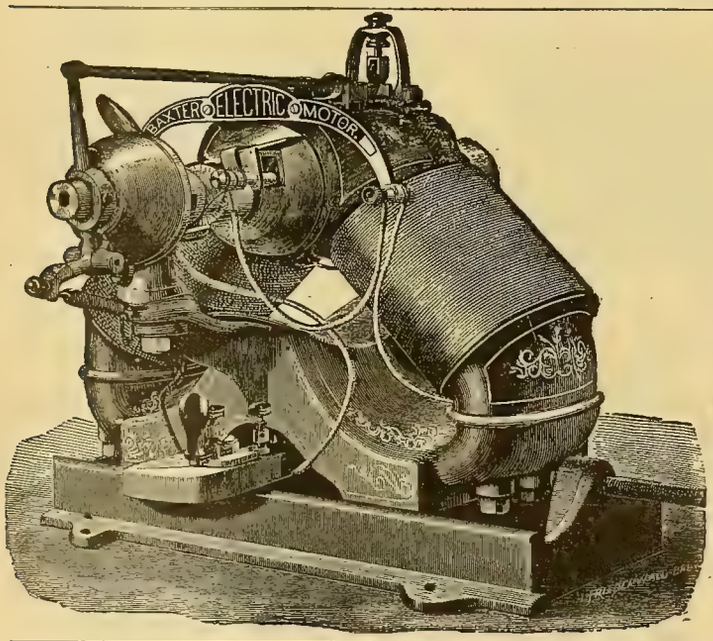

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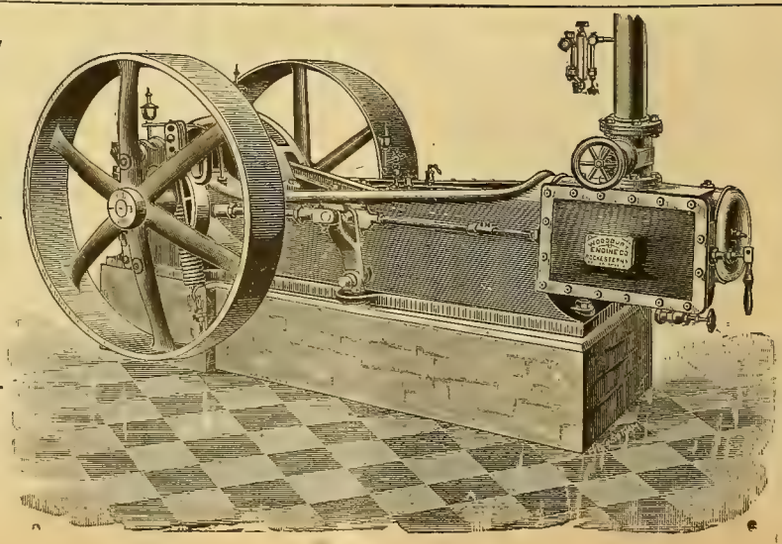

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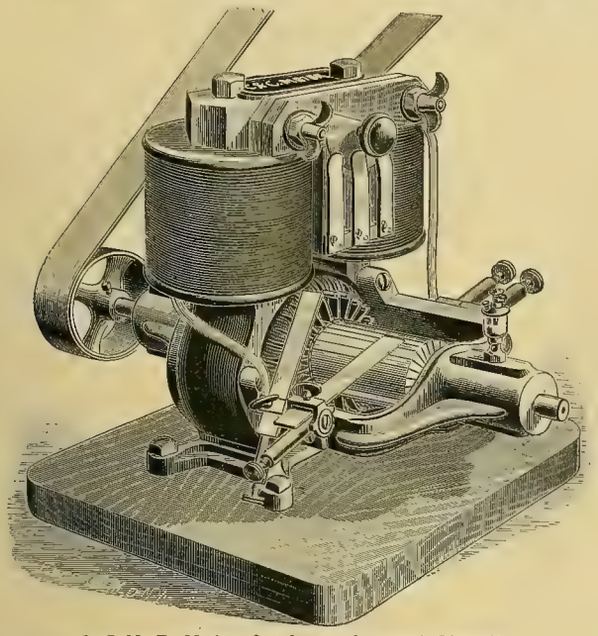

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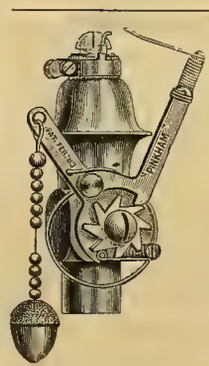

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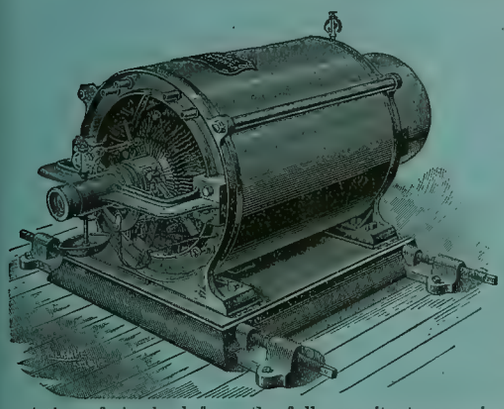

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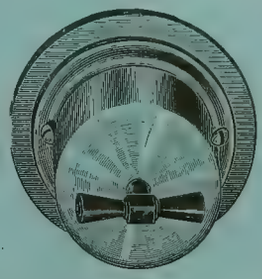

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(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

SLATTERY INDUCTION SYSTEM

MANUFACTURED AND CONTROLLED BY THE

Fort Wayne Jenney Electric Light Company,

FORT WAYNE, INDIANA.

The most carefully worked out and complete Alternating System of Electric Lighting in Existence.

ARMATURE

Guaranteed

Converter

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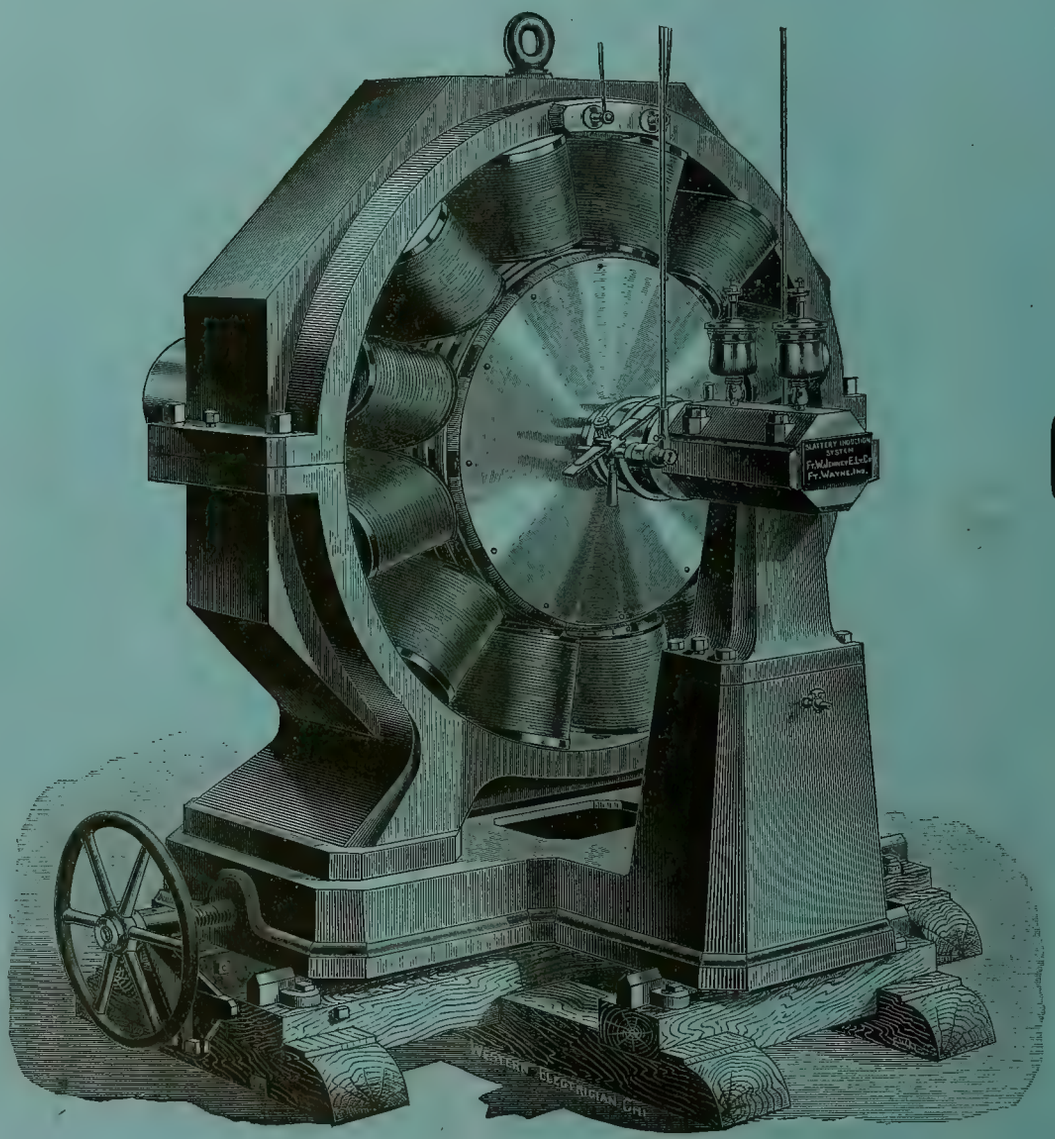

12

16

Candle Power Lamps

TO THE

Horse Power Guaranteed.

SLATTERY ALTERNATING DYNAMO.

Fort Wayne Jenney Electric Light Company,

MANUFACTURERS OF

The Slattery Induction System,

AND

THE JENNEY ARC DYNAMO AND LAMP.

Main Office and Works, FORT WAYNE, IND.

NEW YORK OFFICE: 242, 244 E. 122d St. New York Electrical Construction Co.

CHICAGO OFFICE, 115-117 Monroe Street,
W. J. BUCKLEY, Manager.

PHILADELPHIA OFFICE, 26 N. Seventh St.
G. A. WILBUR, Manager.

CITY OF MEXICO OFFICE MEXICO, F. Adam, Successor.

Western Electrician.

EVERY SATURDAY.

Vol. II. CHICAGO, MARCH 24, 1888. No. 12.

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Standard Underground Cable Company,

General Offices, No. 708 PENN. AVE., PITTSBURGH, PA.

Branch Offices: { New York, Telephone Building, Cortlandt Street. G. L. Wiley Manager. Chicago, 139 East Madison Street, F. E. Degenhardt, Manager.

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For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial.

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Five Years of Uniform Success Enable us to Guarantee our Cables.

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

All Sizes *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use, Concealed Wiring in all Locations.

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LEATHER LINK BELT TESTIMONIAL.

EDISON ELECTRIC LIGHT CO.,
16 & 18 Broad Street,
NEW YORK, Oct. 28, 1887.

Messrs. Chas. A. Schieren & Co., 47 Ferry Street, N. Y.

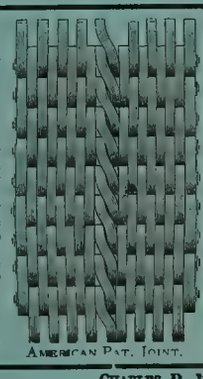
Gentlemen:—I have been using two of your Leather Link Belts in my Electric Plant at Greenwich, Conn. for the past two months and can bear eye witness to the fact that they possess many important advantages over any and all belts with which I have had experience.

They impose less strain upon the Dynamo bearings and consequently allow of no heating and the use of less oil. As they are invariably run under little or no tension, the vibration due to different atmospheric conditions ceases to be a matter of consequence.

These are their chief points of superiority though not all, I am of the opinion, for instance, that a belt of this character will outlive the purchaser in every case.

I recommend them to all Electric Light Manufacturers and users.

Yours Very Truly,
EDWARD H. JOHNSON.



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BITITE and TRINIDAD

INSULATED WIRES AND CABLES.

Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

TRINIDAD WIRES for Line Work in place of Underwriters.

ELECTRIC LIGHT WIRES of all sizes a SPECIALTY.

NEW YORK SAFETY STEAM POWER CO.,

Builders of High Grade Self-Contained

Automatic Cut-Off Engines,

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And other duty requiring close regulation of speed.

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Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

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CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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ADDISON H. NORDYKE, Vice-President.

CHARLES D. JENNEY, Electrician.

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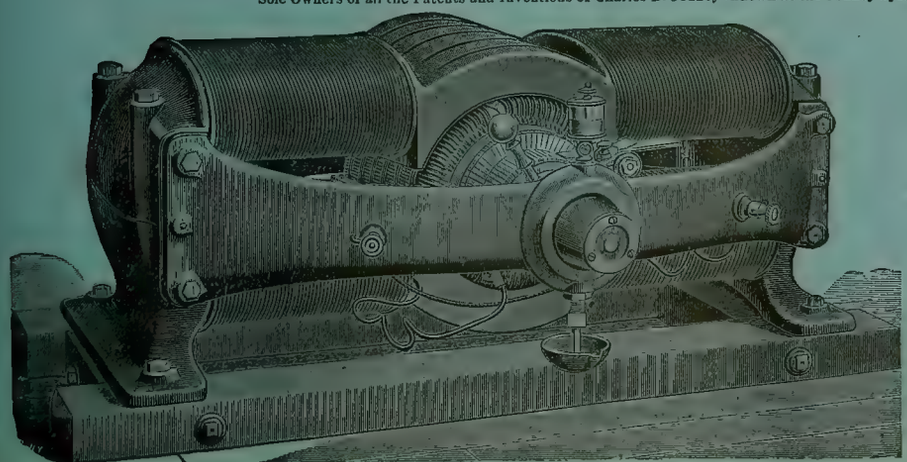
JENNEY ELECTRIC COMPANY.

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Arc Lights for Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

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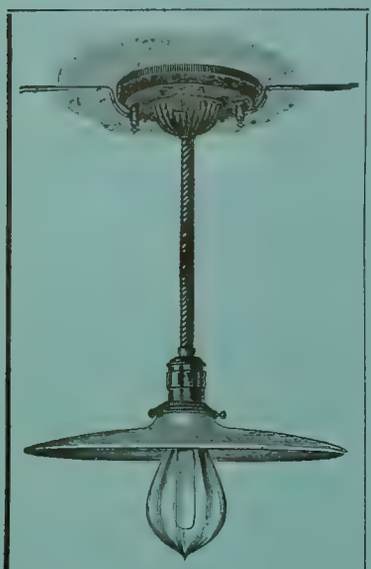
SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.



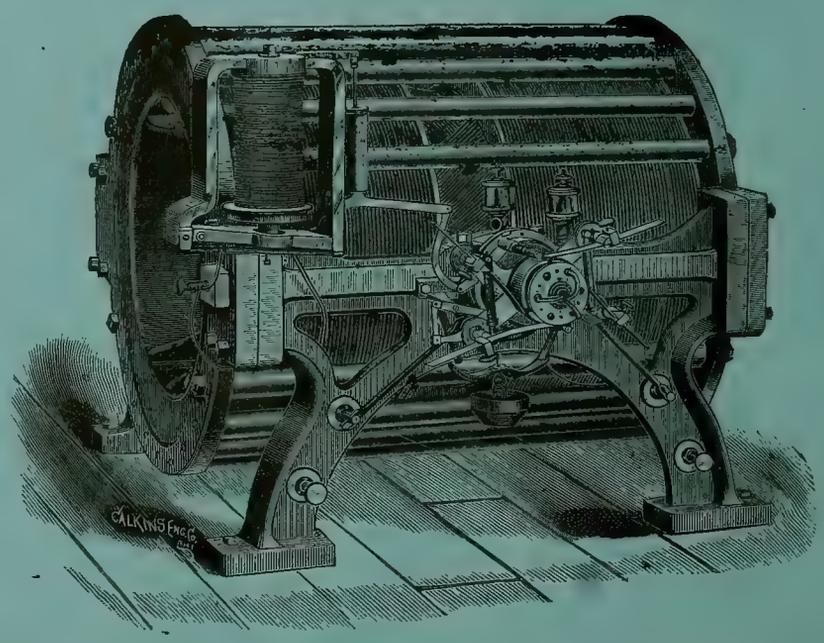
SERIES LAMPS

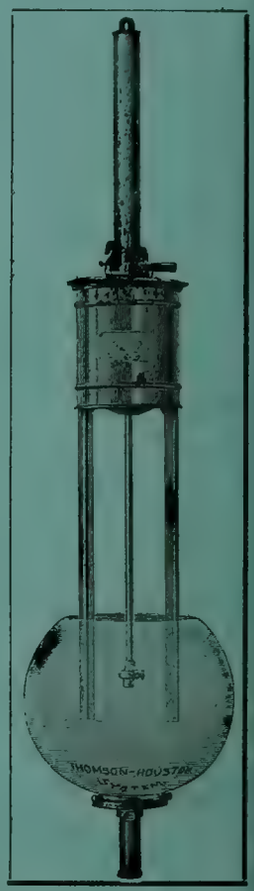
— FOR —

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



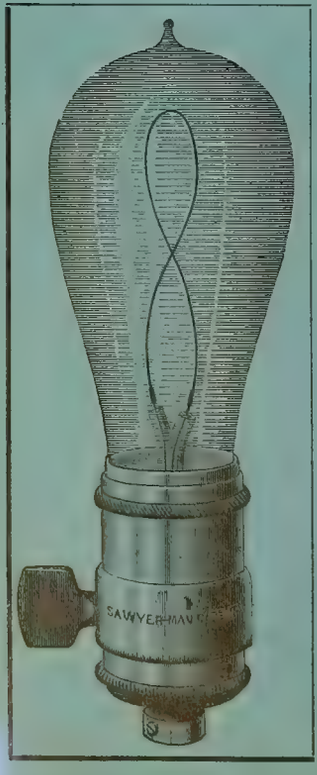


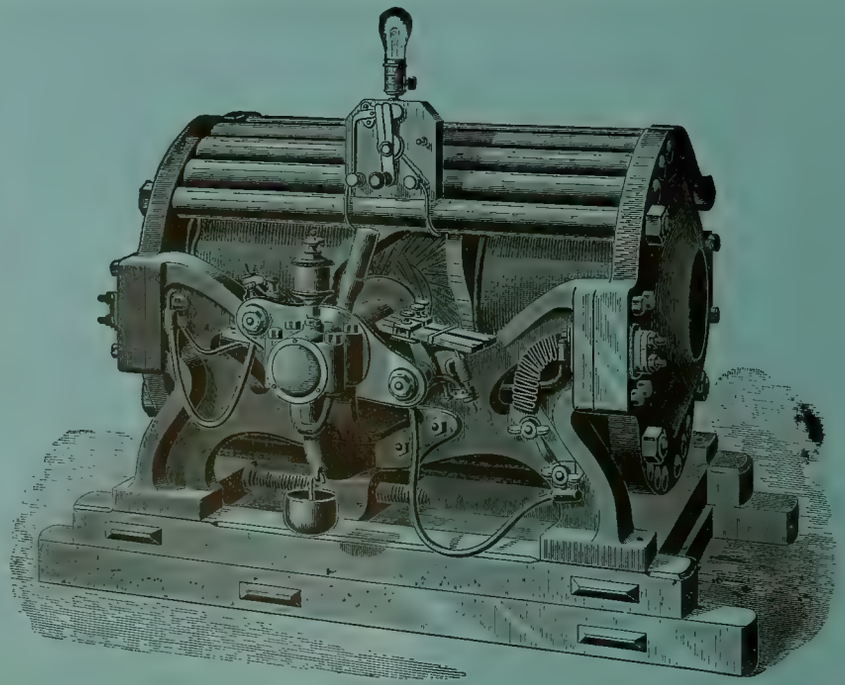
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS.

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc, and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

Chicago & Northwestern R. R.

Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.
G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

LEONARD & IZARD, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(SIGNED) G. H. THAYER, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{50}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS. FOR PARTICULARS, APPLY TO

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THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

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—MANUFACTURED BY—

RICHMOND CARBON COMPANY, NORTH ADAMS, MASS.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

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HERETOFORE KNOWN AS

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For the Electric Light, Telephone and Telegraph,

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Complete Steam Plants

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CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

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Plans and Estimates Furnished for all kinds of Incandescent Lighting.

SAWYER-MAN ELECTRIC COMP'Y. SAWYER-MAN SYSTEM. TRADE MARK

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

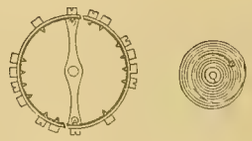
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

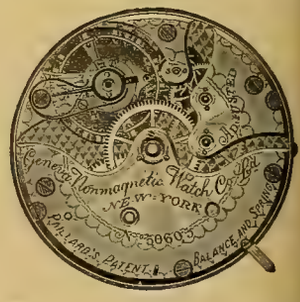
WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**



These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

For Sale by all First-class Jewelers.

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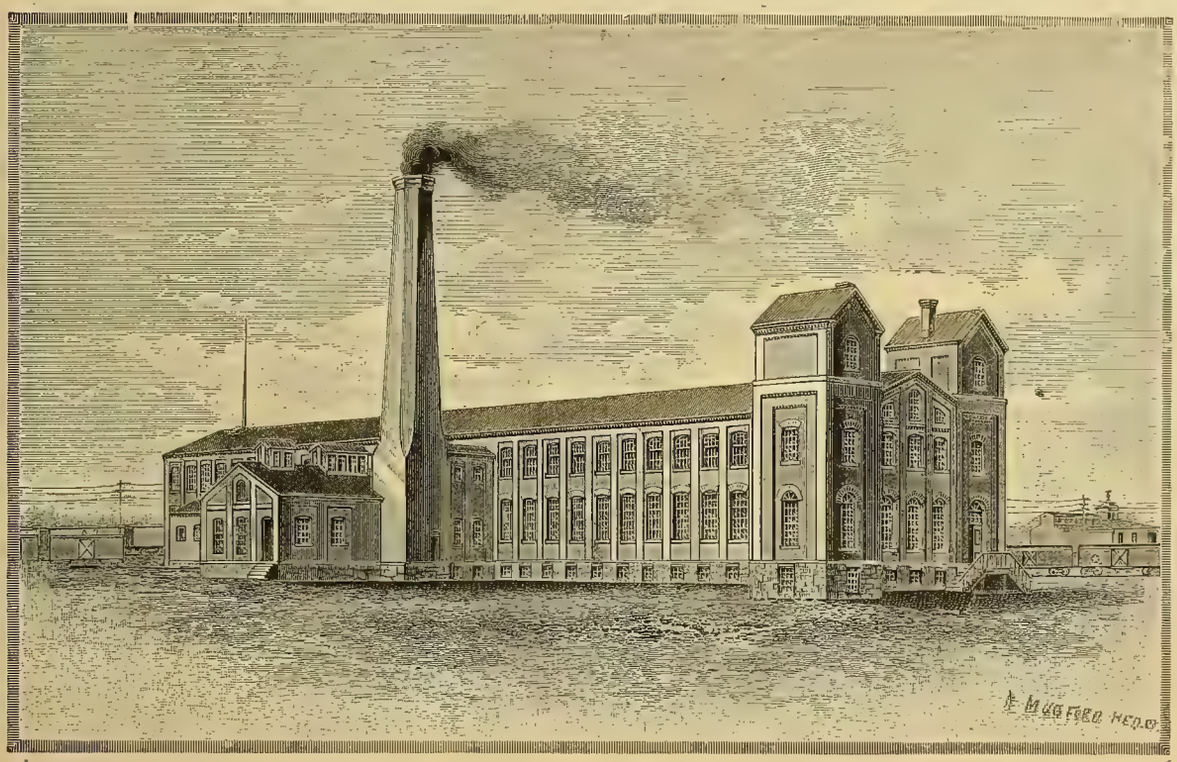
We make instruments for Electrical Measurements, adjusted to any degree of precision required for any purpose. Resistance boxes are made with any required series of resistances, with and without proportional coils for bridge. All resistances are adjusted to legal ohms by standards tested at the Cavendish Laboratory and certified by the British Association Committee.



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required for physical research, all the coils will be made from one piece of wire, to insure a uniform temperature coefficient. Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order. Ammeters, Voltmeters and Resistance Coils will be calibrated, and constants furnished.

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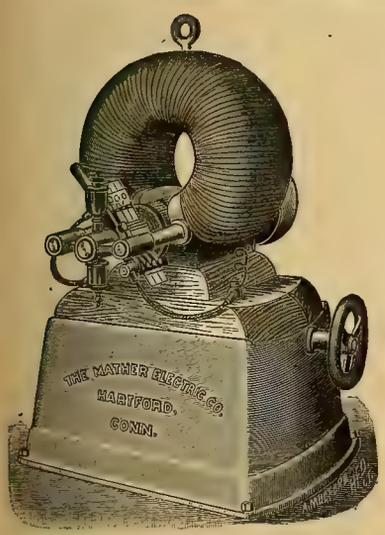

The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.

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We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuits.

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The Tucker Electrical Manufacturing Co.,

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SOLE MANUFACTURERS OF THE

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SELF CONTAINED AND SINGLE CRANK
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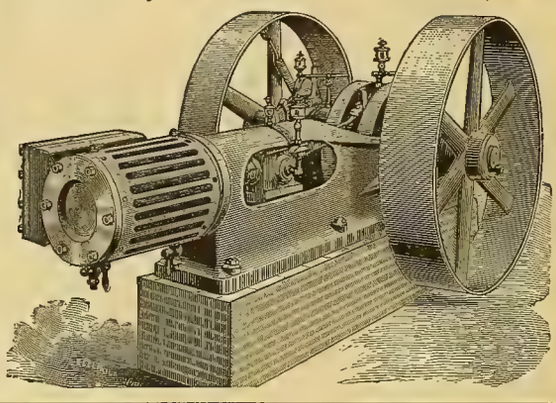

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No. 10 S. Canal St.
CHICAGO.

H. S. WALKER, MANAGER.

TELEPHONE 4024.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

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INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

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FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

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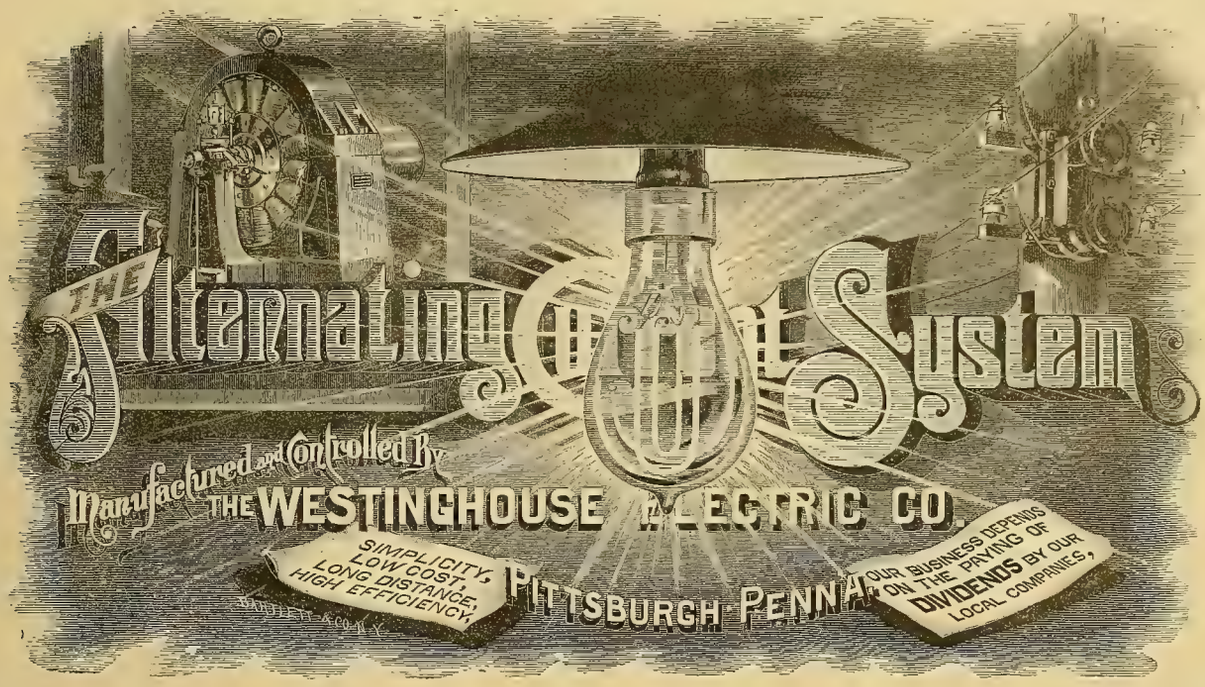

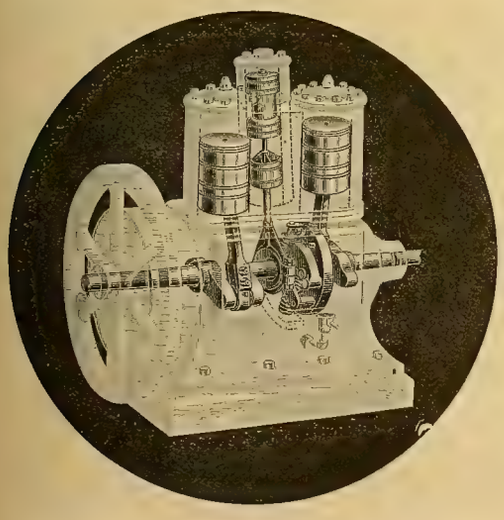

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SHAFTING { Costs to Purchase / Costs to Maintain / Costs to Lubricate / Costs to Drive } VERSUS THE **Westinghouse ENGINE.**

Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

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Pittsburgh, Pa.

THE AULTMAN & TAYLOR CO.,
Represented by ROBERTO BOKER & Co., City of Mexico, Mex.

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Manufacturers of and Dealers in Every Description of

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Hotel and House Annunciators, Burglar Alarms, Bells, Batteries,

AND A FULL LINE OF

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100 pages; 70 illustrations; flexible cloth binding; size of type page, 6 x 3 inches.

Designed for Dynamo Tenders and Linemen, Stationary and Marine Engineers. Just the book for men who wish to learn how to operate and care for electric light installations.

The only book of the kind in the English language. Twenty-one hundred copies of the first edition of 2500 copies already sold.

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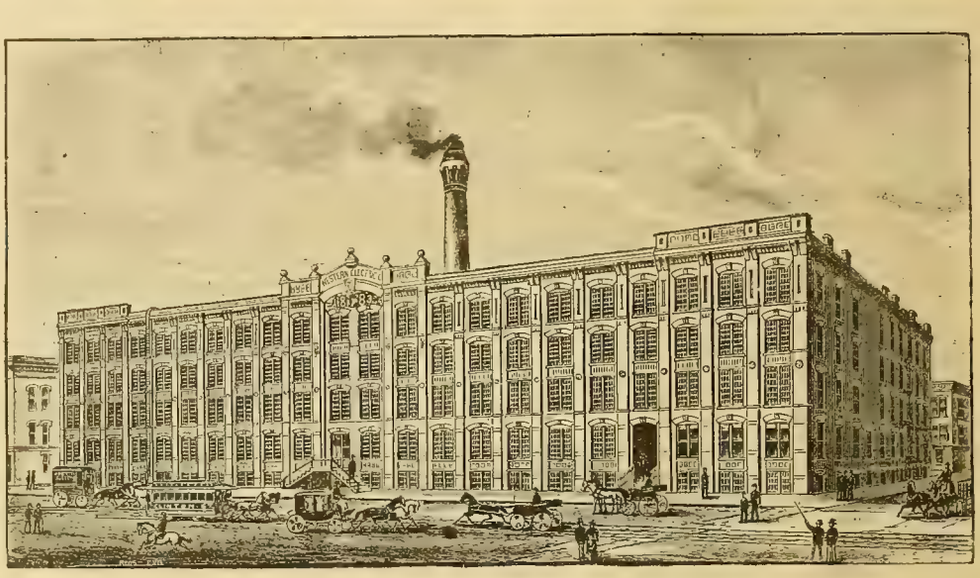
6 Lakeside Building, CHICAGO.

WESTERN ELECTRIC COMPANY,

Chicago. New York.



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EVERY SATURDAY

Vol. II. CHICAGO, MARCH 24, 1888. No. 12.

Combined Galvanometer, Ammeter and Voltmeter.

The instrument shown in connection is designed to measure currents, electromotive forces and resistances. It has a capacity of measuring current intensities accurately to 1,000 amperes, electromotive forces to 3,000 volts, and resistances to infinity. The instrument was designed and constructed by Foree Bain, of Chicago, for the United States government, at Washington, D. C., for the use of the inspector of electric light plants. It may be said here, to the credit of Mr. Bain, that he was not furnished any drawings or specifications for the construction of the instrument, but his design was accepted at once when it was presented to the government's experts.

The instrument is made of bronze metal and is highly finished, except the conducting rings, which are made of rolled wrought copper. The frame is supported by leveling screws which have steel points in their ends; the weight of the instrument sinks these points into the wood up to the round part of the screw and thus it is held firmly and at the same time the screws may be used freely to level it.

There is a swivel between the base plates which is tightened by the thumb screw. The object of this swivel is to furnish means for adjusting the instrument after it is set, without disturbing the leveling screws. It swings freely, and may be tightened whenever the needle pointer finds the zero on the scale.

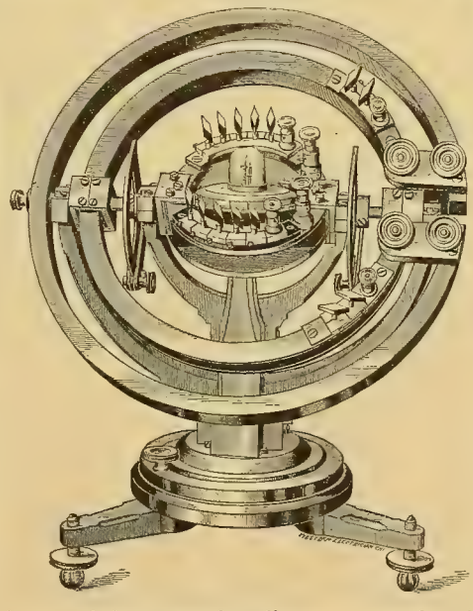
Just above this swivel there is another swivel, which is also tightened with a set screw. At this point will be noticed a bevel graduated disk which is divided into 180 degrees. On the lower disk there is a pointer which indicates on the upper one the number of degrees. The instrument is swung bodily when measurements are made by the sine method.

The frame to which this bevel graduated disk is attached carries three conducting coils, the needle box and the needle. The needle box or case contains the steel needle, to which is attached a delicate aluminum pointer; to the lower end of the needle is attached a small lead ball which holds it in a horizontal position and prevents it "dipping" when the rings are turned; this system is all suspended from the top of the bevel plate glass above by a fiber of a silk cocoon. A glass thimble covers the fiber and adjusting screws as shown. Between the pointer and the needle there is a mirror which prevents any error which might occur from false readings due to improper parallax. There is a magnifying glass mounted on a frame surrounding the needle, which may be moved to any point on the scale. The bevel on the glass cover plate serves also to correct any false readings, which might occur. When looking at the pointer through this bevel if the parallax is not perfect, the pointer appears as if broken into two pieces. The needle case carries a scale which is divided into degrees on one side up to 180 and into a tangent scale on the other side.

The small or inner ring is made of rolled copper of ⌐¬ shape in cross sections; it is 6 in. in diameter, ¾ in. thick and 1¼ in. wide; it is wound full of copper wire which composes five coils of various resistances from .03 of an ohm up to one of 4,500 ohms and in addition the ring itself is used for heavy currents. These coils are arranged so that they may be connected in series, or multiple differentially or conjointly. Both this ring and the one immediately outside of it, which swing from a perpendicular to a horizontal position, carry an independent vernier scale for indicating the degree or angle to which the rings are swung.

The ring on the extreme outside is composed of a solid bar of copper, equal to one square inch in cross section, it is detachably connected to and carried by the middle ring, and may be either in series, or shunt with it, and may be either differentially or conjointly connected in either case. The middle ring is the same as the smallest one, only that it is 12 inches in diameter and carries but two other coils, one of which is 25 ohms in resistance, the other is 16,500 ohms resistance. These coils may also be connected with those in the smaller rings if so desired.

The instrument may be used as a tangent, sine or differential galvanometer and the readings by one method may be quickly checked by the two other methods. The advantages gained by these combinations will be appreciated by those who understand the use of such instruments. The swinging of the rings from a maximum to a minimum point, and their differential action has



increased the range of readings very greatly. A further improvement is in the correction of any error which might arise from the variation in the horizontal component of the earth's magnetic force in different localities.

The current density in the copper rings when measuring heavy currents is only about 400 amperes per square inch cross section, while that in the German silver resistance coils used in measuring high electromotive forces with the proper additional resistance coils is about 50 amperes per square inch surface. Therefore there is not sufficient heat to affect the readings, if they are taken within a reasonable time.

Purchase of the Van Depoele Motor Business by the Thomson-Houston Co.

Negotiations, which have been pending for several weeks, have resulted in the purchase by the Thomson-Houston company of the entire motor business of the Van Depoele Electric Manufacturing company of Chicago. The purchasing company paid for the business in cash. The amount is not stated, but the sum was perfectly satisfactory to the members of the Van Depoele company. In addition to the purchase price, a royalty is to be paid to the Chicago company. The purchase includes the control of the business in the United States only; the right to manufacture for foreign countries is retained. The purchase includes all the patents owned by the Van Depoele company relating to motors and railways.

The Thomson-Houston company has made a contract by which Charles J. Van Depoele, the electrician of the company which bears his name, shall enter the service of the corporation. It has not yet been decided where his quarters will be, but probably his residence will be in Boston or in Lynn, Mass.

The Thomson-Houston company, with an abundance of ready capital, is expected to push the electric railway. The members of that company have the greatest faith in the future of this mode of transit, and they also see a large amount of money in the enterprise. The motors will be constructed at the company's factory at Lynn. Patterns are now being made at the factory of the Van Depoele company.

The Chicago company will now devote itself exclusively to the electric light. In future, incandescent, as well as arc light plants, will be installed. In speaking of the change, Manager A. K. Stiles said to a representative of the Western Electrician: "We now will have plenty of capital to conduct the electric light business. As a matter of fact, we had more than we could handle before this change. We expect to push the business, and we are going to be represented in every state in the union. We have a new improved light, and we can devote our whole attention to introducing it. We hope, too, that the Thomson-Houston company will extend the railway business. They have obtained a valuable business by the purchase."

"Have you any objection to stating the amount paid by the company?" was asked.

"I don't think I ought to do that. It would hardly be fair to the purchaser. I may say, however, that the price was large, and that it was perfectly satisfactory to us."

It is a matter of regret that a business which promised so well, should leave Chicago, but it is gratifying that the rumor that the entire business of the company was to be removed to the east proves unfounded. It has been for a long time a recognized fact that the Van Depoele company needed a larger capital to conduct successfully its motor business, and it was supposed that the needed money would be forthcoming from Chicago capitalists. The capital did not come, however, and a change such as that which is now made public was not unexpected.

The Van Depoele electric railway and the Van Depoele electric light systems are both based on inventions of Charles J. Van Depoele. The latter is a native of Belgium. He began experimenting in electricity at an early age. While in attendance at college, he produced his first electric light, with a battery of forty Bunsen cells. He took a thorough course in electrical studies at the Imperial lyceum. He came to this country in 1869, and continued his electrical studies, though engaged in business. He experimented considerably with motors, employing the power to drive machinery in a furniture shop in Detroit. Subsequently he came to Chicago as the best field for putting his inventions into practical use. A company was formed, and it has met with no little success in all its departments.

The acquisition of the Van Depoele motor business adds another important department to the Thomson-Houston company's business. The operations of this company are becoming simply gigantic, and their business is of a world-wide character.

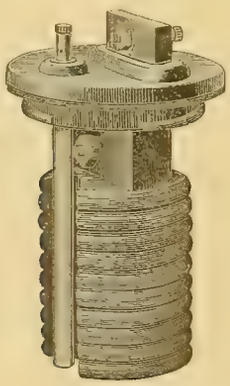
New Magneto Bell.

The accompanying cut of a magneto bell, shows the new style of telephone switch or hook being manufactured by the Railway Telegraph Supply company, of Chicago. The magneto bells are furnished with or without the switch. It is claimed that these bells excel in efficiency, durability and appearance. The company is manufacturing them in large quantities, to meet an unusual demand. Two of these bells were recently employed in the long distance telephone experiment between New York and Chicago. With these bells Chicago had no difficulty in ringing up New York, and the operator at the latter place experienced no trouble in ringing up the Chicago bell.

Telegraph and the Blizzard.

Residents in eastern states last week were brought face to face with the fact that they had never properly appreciated the blessings supplied by the telegraph. Hereafter they will realize more keenly the importance of the telegraph as a factor in modern life. The effect of the blizzard was to isolate completely cities and towns by the score. The storm played sad havoc with telegraph lines throughout the east. Never has there been a time in the history of telegraphy in this country when the service was so completely crippled. As soon as this condition was found to exist, so the reports say, almost every man, woman and child found that to send a telegraph was the thing at that time most to be desired.

The almost complete absence of New York despatches in the newspapers told the story of the isolation of the metropolis. The telegraph service was shattered and New York was silent. The press report in a condensed form was sent to a few places in New England by long distance telephones. Those whose business it is to distribute and collect news worked heroically to keep up their records but the odds were too great. For several days New York distributed little news. On Friday the Western Union had wires working to Philadelphia and Washington but they were in poor shape. The cable companies had no little trouble. As late as last Saturday a report of the cable service was as follows: "The Commercial Cable company's lines are working without obstruction. The French Cable company has one land wire working. The Anglo-American Cable company reports that delays are much less to-day than yesterday. The Direct Cable company's land wires are working



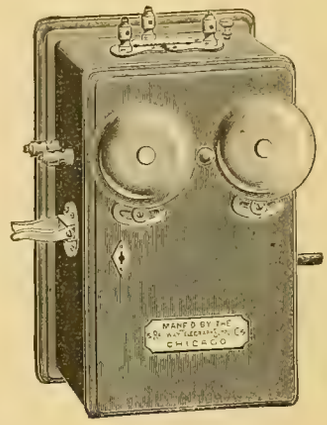
steadily but slowly. Hopes are entertained that full communication with Europe will be resumed from this side early next week."

On Saturday the Western Union was enabled to partially resume business on a limited number of wires working to Buffalo, Cincinnati, Detroit, Chicago, Pittsburgh and Philadelphia. Boston had one wire only; also one wire working to the Sydney cable station. Through the state there were eight wires working to Albany, one duplex to Syracuse, another to Rochester. The wires were working on the east side of the Hudson River as far as Poughkeepsie and on the west shore as far as Newburg.

The railroads suffered severely as a result in the break in telegraphic communication. The officials of the Pennsylvania railroad made use of the long distance telephone in the New York *World* office. The *World's* telephone wire is a special size copper wire heavily insulated and strung on separate poles.

The business loss consequent upon the isolation of the metropolis can hardly be estimated. For several days many important enterprises were positively at a stand still, as it was impossible to transmit orders from other cities.

Boston was out of the world from Monday morning until Wednesday. Then communication was established by the Atlantic cable. The officers of the Western Union company at Boston reported Monday evening that the western and southern lines were down, and they could see no chance for communication. The heavy wind blew down the telegraph poles, and as they fell on the railway tracks the trains were in constant danger. The storm in Boston and vicinity tore down the telephone and fire alarm wires, and the crossing of electric light wires caused at least



one serious fire. The bankers and brokers were unable to transact business, as they could not obtain quotations from New York. Wednesday night, New York found Boston by means of Albany, but the connection was soon lost. Thursday the embargo was declared off. This facetious remark was made by a Chicago paragrapher; "Boston, while buried under the snow drifts, could still communicate with London and Mr. Sullivan, and what did it care if its communications with the rest of the world were cut off?"

The storm treated Rhode Island in about the same way. The whole state was at one time wholly without telegraphic communication. In Vermont the situation was almost as bad. On Wednesday no communication was received in Boston from any part of the state.

In Connecticut the telegraphic lines are still in bad condition. Despatches from several places were sent to New York papers by steamers. From Monday to Wednesday Ansonia was without communication. The first news it was able to receive came from New Haven by means of a telephone. It was Sunday night before New Haven was able to report direct communication with Boston and New York. Maine suffered less than any New England state.

New Form of Law Battery.

The Law Telephone company of New York, have recently put upon the market the new form of battery so clearly shown in the accompanying illustrations. The negative element as will be noted is in one body and has a surface of considerably larger area than the old form which has been discarded. The negative element thus increased in both quantity and area enables the battery to hold up longer when overworked and to recover more quickly when relieved. The item of breakage in transportation is also reduced from the fact of the greater strength of the element.

Felix Lambotin, a short-hand writer of Epernay has submitted what he styles a stenotelegraphic instrument for the consideration of the French postal and telegraphic commission. By means of the apparatus messages in stenographic characters are projected by electric light to great distances on screens arranged for the purpose. The inventor asserts that the apparatus possesses many features of excellence which would render it a great service in transmitting signals in time of war.

Practical Telephony.

By Thos. D. Lockwood.

VII.

In what has been already said about the magneto telephone, it has been assumed that the magnet is a bar magnet. Of course a horseshoe magnet is just as readily used, and often is used. Before the introduction of battery transmitters, the Bell Telephone company put out an instrument called the box telephone, in which a heavy horseshoe magnet was employed, with a spool of wire on each coil, and a comparatively large diaphragm. This was a very efficient magneto transmitter, and had a deep base tone.

In talking with a magneto telephone as a transmitter, it is not necessary usually to speak loudly as distinctness is what is wanted, and the magneto telephone is unexcelled for the latter quality. But it also has this advantage: If for any reason it does become necessary to speak loudly you can speak as loudly as you wish, as there are no electrodes to force apart, causing the noise known in connection with battery transmitters as breaking; and the currents generated will moreover be increased and the reproduced speech will also be comparatively louder, as you raise your voice.

A system of two magneto telephones joined together in an electric circuit, Fig. 13 constitutes the simplest arrangement known for the electrical transmission of speech, because the instruments are equally competent to transmit, and to reproduce or to receive.

As I think that everyone who works with telephones or for the matter of that, with any kind of electrical appliances, should know how and why they work, I will here devote a little space to the why and wherefore of the magneto telephone. Think of it in the first place as a transmitting instrument. You have a magnet, a coil of wire surrounding the pole of the magnet, and a diaphragm or thin plate of iron mounted with fixed edges, and with its center opposite and quite close to the pole—but it must not touch. In the earlier part of these papers when describing the operation of the bell and generator, I explained at some length the principles of magneto currents and their development; it is therefore not necessary to go into further details upon that subject. I will now assume that these principles are known. It is then easy to see that the magnet in the magneto telephone used as a transmitter is the source of power. It is like the spring

or weight of a clock when wound up; or like a steam locomotive with a full head of steam, but with the throttle closed. The helix which surrounds the coil, has its ends included in the line circuit, and as may be imagined is in a strong magnetic field. That is, it is in the strongest part of the influence of the magnet, and the magnetic lines of force pass through the coils. The diaphragm is really an armature for the magnet; it is found that when a piece of soft iron is moved near a magnet, the magnetic rays —so to speak—of the magnet are deflected or bent, or squeezed out of their first position; and if the motion is continued, these lines or rays keep on changing. This change we call a variation of the magnetic field. But it is equally true that if a wire forming part of a closed circuit be within the magnetic field which is so

varied, electrical currents are set up in that wire, which traverse the circuit of which it is a part; also that these currents vary in strength, direction and character, with the changes in the strength of the magnetism; also with the amplitude, direction, and character of the motion of the piece of iron, the diaphragm in front of the magnet; and finally that the diaphragm will in its movements copy faithfully the movements of the air which affect it. Having reached this stage, it is not difficult to see that if these processes closely copy or echo one another the last will not be materially different from the first, and the electricity set up or developed in the circuit, will vary in strength, direction and character, with the variations in loudness, pitch, quality or character, of the spoken words uttered in front of the diaphragm; unless these conditions are complied with, speech can not be transmitted; and if any of them are imperfectly complied with, the transmission is imperfectly affectuated. Thus when we speak, in front of the diaphragm of a magneto telephone, we cause the diaphragm to vibrate, and its center alternately bulges in by the impact of the sound waves, and is drawn out by its own elasticity alternately. The natural rate and character of the vibration of the diaphragm is repressed, because its edge is compressed by the cap of the telephone, consequently the vibration can only copy the sound waves which strike it. When the diaphragm center moves inwardly, the magnetic field is changed, and a current is set up in the helix in one direction; when it moves outwardly it is changed again and the current is set up in the other direction; and these currents pass over the circuit to affect the receiving telephone.

The moral of all this is, that the sound vibrations are copied by the mechanical vibrations of the diaphragm, these by the magnetic vibrations of the magnet; and these by the electrical changes in the circuit: thus even in the half process of transmission only, we see no less than three transformations of energy. The operation of the telephone is one of the finest illustrations known of the doctrine of the conservation of energy—since we see the changes of 1, sound into mechanical motion; 2, mechanical motion into magnetic vibration; 3, magnetic vibration into electricity.

Let us now consider the magneto telephone as a receiving instrument. Suppose we are still considering the same telephone, but instead of speaking to it, we are now listening. The same three essential elements are there, the magnet, the coil and the diaphragm; but the function is diametrically opposite. Instead of sound being transformed into electricity, electricity is turned into sound. The electricity coming from the other station passes round all the convolutions of the magnet helix, and then back to the transmitting station by the return wire, or to earth; but in passing round the magnet core it performs some work on it. What is that work? What work does a current of electricity perform when it passes round any soft iron core? Does it not make a magnet of that core? But this core is a magnet already. Remember that the currents coming from the other station are alternating in direction—the core or pole piece being already magnetized, is then not initially magnetized by the coming currents, but its magnetism is alternately increased and lessened. It may be stated, however, for the benefit of inquiring minds that if the core were not at all magnetized to begin with, the operation of the incoming currents would be to alternately magnetize and demagnetize it, and then to magnetize it oppositely. What next happens? The pole piece being at the outset a magnet, naturally exercises a steady pull even when at rest upon the center of the diaphragm; so that when the strength of the magnet is increased by the arrival of a current of proper direction, the result is that the pull upon the diaphragm is increased; and when the next current of opposite direction comes along, the pull is momentarily lessened. But this alternate increased and decreased pull is not effected suddenly, but gradually, so that we may properly say that the magnetism of the pole piece is varied, and more, is varied exactly in accordance with the variations of the electric currents causing it, and that the pull upon the diaphragm is varied in like manner. The diaphragm thus vibrated, in turn moves the mass of air immediately in front of it, and this finally vibrating at the proper rate, and impressed by the moving diaphragm with the proper quality reproduces the original sounds. Here again it will be seen that we have three transformations of energy; namely, from electricity into magnetism; from magnetism to mechanical motion; and from mechanical motion into sound. And by means of the six transformations we have described, words uttered at one station are not transferred to, but are reproduced at another.

We now have to consider the battery transmitter. The Blake transmitter has been more widely used than any other transmitting appliance, although it is a later invention than the carbon transmitter of Edison.

Externally, its appearance is nothing extraordinary. A black walnut box, five and three-eighths inches high, four and three-eighths wide,

Fig. 13.

and two and a quarter inches deep. In the center of the front piece is a circular hole, having a diameter of half an inch, through which the sound waves of the voice are directed upon the diaphragm, and which is provided externally with a flare or countersink serving in some sort as a mouth piece, although it is merely cut into the thickness of the front piece, and does not in any way project. A black spot at the center of the mouth piece, betrays the presence of a japanned diaphragm, but otherwise there is nothing to indicate the character of the operating features. A close inspection will, however, show that the diaphragm is not close to the mouth piece, but is separated by a space of about three thirty-seconds of an inch. This construction comes about by placing the diaphragm on a shoulder or offset inside, whereby a flat chamber is constructed between the outer surface of the diaphragm, and the inner surface of the front board or door of the transmitter box. This flat condensing chamber is one of the features which show the close relationship between the variable resistance transmitter and the magneto instrument. It seems necessary to perfect articulation in all telephones.

Now let us open the transmitter and see what is inside. Notice first that there is not very much mechanism, that what there is, is chiefly mount-

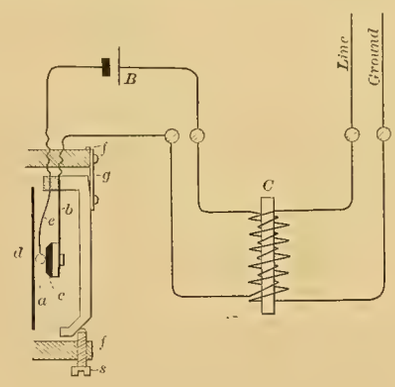


Fig. 14.

ed upon, and fixed to the door of the transmitter; and that the door is joined to the box by hinges through which an electric circuit passes. To aid in maintaining the continuity of this circuit, in the condition of the theoretical Cæsar's wife, a flat spring is screwed by one of its ends to the hinge, and its free end presses outwardly so as to aid in preserving contact between the two sides of the hinge.

In the drawing Fig. 14, the working parts are shown in diagram. The diaphragm *d* in practice, lies in a cast iron frame or ring-seat, and has around its edge a soft rubber or elastic ring which overlaps both sides; and the ring-seat has two inwardly projecting lugs *f*, to which the electrodes or variable resistance elements and their adjusting apparatus are fixed. A thin flat steel spring, incased at one end in a soft rubber glove, with a piece of cloth on its under side, is fixed at its other end by a screw, to the cast iron ring-seat; and presses with its gloved end upon the inner surface of the diaphragm at a point between its edge and center. This is called the "damping" or "dampening" spring, and its office is to quickly check all vibrations, and especially to prevent the natural vibrations of the plate itself, which tend to confuse the vibrations artificially imparted to it by the voice. This device enables the diaphragm to be kept more completely under the control of the voice, and causes it to more closely copy in its vibrations the sound waves which produce them. Directly opposite to the position of the damping spring a small brass clamp screwed to the frame presses upon the edge of the diaphragm, or rather upon the rubber ring which encases it. Note here, that the diaphragm is only held in place by the single clamp and the damping spring; and that therefore it is never rigidly fixed, but is at all times adapted to respond to the action of the voice in transmitting. The adjusting lever *b* is fastened to the upper lug *f* by a light but stiff German silver strap *g*, and terminates at its lower extremity in a bevel face, against which impinges the adjusting screw *s* which passes through the lower lug *f*. The upper end of the adjusting lever bends toward the diaphragm at right angles, and sustains the ends of two light flat springs, one of which is however much lighter than the other. They are insulated from one another both at the point of dependence, and throughout, the larger one being loosely incased in a soft rubber tube. The spring *e* which is nearest the diaphragm is the lightest, and at its lowest end which reaches a point opposite the center of the diaphragm, it carries a small bead of platinum *a*, shaped something like the head of a pin. The heavier spring *b* carries a button of hard carbon *c*, which is polished on its surface. This spring is so arranged that when the screw is properly adjusted, the carbon which has considerable weight presses against the platinum bead holding it with considerable firmness against the diaphragm, and preserving also its own contact with the platinum. By this means breaks of continuity are prevented. Four binding screws are provided on the inside of the rear wall of the transmitter box near the top; and ignominiously standing in the corner at the bottom of the box may be seen a small ordinary induction coil C. The diagram shows the circuits. From one pole of a battery B—usually a single cell of LeClanché—the circuit is led by means of one of the left-hand pair of the screw terminals to the platinum bead *a*, thence by contact to the carbon button *c*, and spring, to the metal adjusting lever *b*, then to one of the two circuits of the induction coil, and through that circuit back to the other pole of the battery. The main line circuit has nothing to do with the battery circuit directly.

The line enters by one of the right hand pair of screw posts passes through the remaining circuit of the induction coil, and out again to earth or to the next station by the other screw post. A further description of the coil and operation of the transmitter will be given in the next paper of this series.

(*To be continued.*)

Western Union Report.

The Western Union Telegraph company has declared a dividend of 1¼ per cent. The earnings for the quarter ended March 31st, are estimated at $1,250,000. Interest, dividends, and the sinking fund payments require $1,220,003, leaving a surplus from the quarter's earnings of only $29,997. The surplus Jan. 1, 1888 was $7,393,714, making the total estimated surplus April 1, 1888, $7,423,710. The gross earnings for the quarter ended Dec. 31, 1887, were fully as large as expected, being within a fraction of $5,000,000, but the current expenses of the Baltimore & Ohio system were temporarily increased by a large outlay of money, to cancel future obligations of useless office leases and other contracts. The cost of repairs and maintenance was also greatly increased during the last and current quarters, owing to the unusua number of snow and sleet storms.

Dynamo Tenders' Hand-Book.[1]

By F. B. Badt.

PART II.

DYNAMO ELECTRIC MACHINES.

Chapter XVII.

Keeping a Dynamo in Good Order.

The dynamo must be kept scrupulously clean, like any other expensive machine. Any good engineer or dynamo tender will do that without being told.

Copper dust, which will be caused by the friction of the copper brushes against the commutator, should never show; it should be cleaned off the armature and fields by means of a paint brush and a pair of bellows every day. Shafts and pulleys running near the dynamo must be prevented, by means of shields, from throwing oil on the dynamo, especially on the commutator.

A brush should never be lifted off the commutator while the dynamo is running.

Binding posts and other contacts should always be tight. A slight vibration of the dynamo, which will occur even when it is properly set, will loosen these connections in time. Every binding screw should be examined, and, if necessary, tightened every day.

Chapter XVIII.

Brushes.

The setting of the brushes is one of the most important duties of the dynamo tender. The brushes should rest against the commutator with a slight pressure. They should not be rigid, but the brush holder springs should allow a certain amount of spring; this will prevent excessive sparking of the brushes, even if the commutator should be a little uneven.

The contact points for the brushes on the commutator are in most dynamos diametrically opposite each other. In order to find these points quickly it is advisable to cut a little strip of tin, the length of which is just one-half the circumference of the commutator, and use this strip as a gauge when setting the brushes. The brush holders should be carefully kept clean, and should be wiped off every time before the brushes are put in. The brushes must extend from each brush holder at equal lengths. The insulation between the brush holder pins and the quadrant must be in good condition; oil and dirt must be kept out.

Fig. 13 shows the proper positions of the brushes. The point where the brushes are resting on the commutator when the greatest current strength is obtained are called the maximum points, *A*, *B*. When the brushes touch the

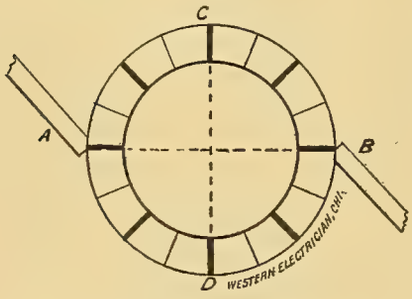


Fig. 13.—Proper Position of Brushes.

points *C*, *D*, at right angles to *A*, *B*, called the neutral points, no current is obtained.

If the brush is nearly worn through to the middle of its thickness, it should be turned over and the other side used on the commutator. When both sides are worn off, as shown in the upper part of Fig. 14, the brushes should be trimmed. In larger stations, little brush cutting machines are used for this purpose; in smaller installations, two blocks of hard wood, lower part of Fig. 14, are used. The brush is put between the two blocks and the whole put in a vise. The end of the brush projecting beyond the wooden blocks is then removed by means of a file.

The brushes should also be in such a position on the commutator that the least sparking will be set up. In some dynamos it is necessary to move the brushes in proportion to the load in order to get little sparking. In other systems, the brushes need not be moved at all, no matter how many lights are turned on or off. In some dynamos, the moving of the quadrant, or, in other words, the moving of the contact points of the brushes on the commutator, is used for increasing or decreasing the strength of the current.

Chapter XIX.

The Commutator.

The commutator is the most sensitive part of the dynamo, and should be especially cared for. It must always be kept smooth. If it should get rough from the electric spark, it is necessary to smooth it by pressing a block of wood covered with fine emery cloth against it, after having set the dynamo in motion with the brushes lifted off. If the commutator is so rough that a smooth surface cannot be obtained by the use of emery cloth, it should be filed. In order to do that, it is necessary to take out the brush holders, pins and brushes. After a straight surface has been obtained, the commutator should be smoothed with fine emery cloth.

The disadvantages of using a file on a commutator are the liability of pressing small chips of copper into the insulation between the copper segments, and the impossibility of getting the commutator true. The best way is to turn the commutator off by means of a little lathe, which can be attached to the dynamo, or by taking the armature out of the dynamo and having the commutator turned off in a lathe in a machine shop. This will not only make the commutator smooth but perfectly true. In filing or turning off the commutator while the armature is rotating in the dynamo, it is necessary to reduce the normal speed of the dynamo considerably, as too high a speed would spoil commutator and turning tools.

In new commutators for which fiber is used as insulation between the copper segments it is very often found that the thin sheets of fiber have absorbed moisture, and extend above the surface of the commutator. If a few days' exposure in a dry warm room does not cause the fiber to shrink and go back to its place, the surface of the commutator must be smoothed first with coarse and then with fine emery cloth.

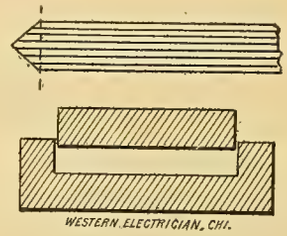


Fig 14.—Worn Brush and Blocks for Trimming.

In most systems it is advisable to put a little oil on the commutator just after starting the dynamo. Very little oil, however, must be used. Dip the point of one finger in one drop of oil, distribute it by rubbing it on the inner surface of the hand and apply what oil remains on the finger tip to the commutator, and take it off with another finger. This will do for at least three hours' run.

If it should become necessary at any time to replace the commutator by a new one, it should be done in the following manner: Take the armature out of the dynamo and put the two ends of the shaft on two wooden horses. Mark the wires leading from the armature to the commutator by attaching little tags with numbers, to make sure of the proper place of each wire after taking off the commutator. Then disconnect these wires from the corresponding copper bars of the commutator, either by unscrewing the set screw, or in commutators which have solid connections, by unsoldering them by means of a hot soldering iron. Take the commutator off, clean the shaft and connections and put the new commutator carefully in its proper position and connect the wires in proper turn to the corresponding copper bars of the commutator by means of set screws, or soldering with hard solder. The greatest care must be observed not to short-circuit any parts of the commutator with drops of molten solder.

Chapter XX.

Repairs.

A, to the Armature.—In most cases repairs to the armature are necessitated by injuries to the insulation of the wire from external mechanical sources or by excessive heat generated in the armature. The first is very often caused by little particles of material dropping in the spaces between armature and pole pieces—for instance, little balls of cotton waste being caught from the end of the dynamo and pressed between armature and pole pieces, thus scaling off the insulation of the wires in some places, or bursting the metal bands. Such injuries can have two different results, either short circuiting some of the coils or bringing different parts of the wire coils in contact with the iron core. These injuries hardly ever extend below the first layer of wire. In most cases it will be possible to carefully lift one wire at a time just high enough to wrap it with silk tape, and thus insulate it. After having wrapped and insulated all the injured parts, drive the wires back into their position by means of a small hard wood block and hammer, and give them two or three good coatings of shellac varnish. If the injuries are below the first layer of the armature, it will be necessary in most cases to have it sent to the factory to be re-wound.

Excessive heat in the armature will very often char the insulation of one or more coils of wire entirely. These coils, of course, must be taken out and replaced with new wire. In most armatures of the so-called Gramme pattern this can be easily done. In armatures of the Siemens drum pattern it will necessitate a re-winding of the whole armature. The over-heating of one or more coils of an armature is very often caused by the short-circuiting of two or more segments of the commutator by means of copper dust which has been allowed to settle back of the commutator, or by excessive sparking of the brushes, forming little bridges of metal across to adjacent commutator segments.

B, to the Field Magnets.—The faults which mostly occur in field magnets consist in short-circuiting coils, or in getting parts of the field wire in contact with the iron core. The field wire should be unwound until the damaged part is reached, and after insulating it properly as described before, it should be wound back on the core. If it should be necessary to take a considerable amount of wire off the field in this way it will be advisable to put the damaged field magnet in a lathe and do the unwinding and re-winding by means of the lathe.

Chapter XXI.

Testing the Wire Coils of a Dynamo for Contact Against Iron.

The iron frame of each dynamo must be well insulated from the wire coils of the field, the armature and also from any connection with the earth. If one of these wire coils should get in contact with the iron frame of the dynamo and the latter should be in connection with the earth by means of foundation bolts, etc., it would cause what is called a ground. This ground must be considered the worst enemy of electric light apparatus, and should never be allowed to exist. We have shown how to test for grounds in Chapter VI. The same method can be applied in testing for contact between field wire coils or armature coils and the iron. During the test, any wires leading to the circuits or other apparatus should be disconnected from the dynamo in order to make sure that the fault really lies in the dynamo itself. Another fault sometimes found in the field of the armature is called a short circuit.

A short circuit is a shunt of little resistance between two points of a conductor. Suppose the points *A* and *B*, in Fig. 15, are set in some way in connection. It is clear that the main part of the current will pass through *A*, *B*, and but very little current will pass through the coil. If this should occur in the armature, the coil thus short-circuited in itself will generate currents of great strength, which will destroy the insulation of this coil in a very short time. Generally the dynamo tender will be warned by a smell of burnt cotton and shellac. If this fault should occur in a field magnet it would decrease its power, and thus cause the different magnets of the field to be of unequal strength. It may cause heating of the field in shunt and compound dynamos, while in series dynamos it will simply decrease the current strength generated by the dynamo. In order to test for a short circuit in an armature coil, or a field magnet, it is necessary to disconnect each field coil, or each armature coil, and measure by proper instruments the resistance of each coil. If any magnet coil shows a resistance below the others, it is short-circuited. The use of the necessary testing apparatus can not be described here, as it would go beyond the limits of this little book.

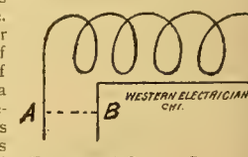


Fig. 15—A Short Circuit.

The short circuits in field coils, however, can very often be found without the use of finer testing instruments, simply by the use of the detector galvanometer and the cell. By connecting each field coil in series with galvanometer and cell, and marking the deflection of the galvanometer, the coil which will show the least deflection is the one which is short-circuited. A short-circuited field magnet will beat less than a sound magnet when the dynamo is generating current. A break of the field wire can very easily be found by means of the galvanometer, as no deflection would be obtained at all through the broken coil. A break in a wire coil of the armature could only be found by disconnecting all wire coils from the commutator and from each other, and then testing each coil separately in the manner described. This, however, would involve considerable work and delay, and a quicker method may be employed: Set the dynamo in operation; then take a short piece of wire and touch the commutator with the two ends of this wire at a distance of three or four segments apart,

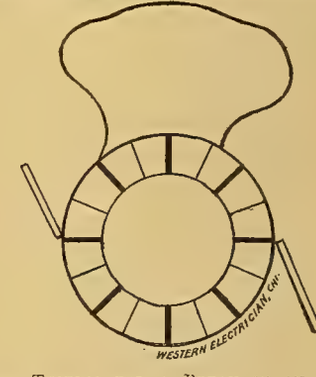


Fig. 16.—Testing for a Break in an Armature Coil.

Fig. 16. If the machine should commence to generate current, an electric arc will be formed on the commutator between the two ends of this wire, and indicate there is a break in the armature wire. The machine must be shut down quickly, as otherwise it would cause damage in the commutator and armature. The coil of the armature in which the fault lies can be easily recognized by the burns on the corresponding segments of the commutator. Faults of this kind are very often found in poor contacts between two coils, or between a coil and the corresponding copper bar of the commutator. Poor contacts will cause more trouble than actual breakage of the wire. Such faults will often destroy certain commutator segments, caused by increased sparking of the brushes when passing these points. Hence, if only one or two commutator segments should show rapid destruction from the electric spark, all the connections between these segments to the corresponding armature coils should be well examined, and, if necessary, cleaned and well tightened, or made solid with solder. The poor contact between parts of the field wire coils can be very often discovered by holding a piece of iron, for instance a machine wrench, near the pole piece without touching it. If the contacts are good the wrench will be attracted with a uniform force; if poor, these forces will vary and cause a singular vibratory motion of the wrench in the hand.

[1] Dynamo Tenders' Hand-Book, by F. B. Badt; 100 pages, 70 illustrations; flexible cloth binding; type page 6 x 3 inches; published by Western Electrician Co., price $1; now ready for delivery.

DISEASES OF DYNAMOS.

CHAPTER XXII.

Non-generation of Current by the Dynamo.

There may be numerous causes for such an occurrence.

First, the residual magnetism in the field magnets of the dynamo may be too weak. Series dynamos can be started in such a case when running at normal speed, by short circuiting the two binding posts with a piece of wire for a fraction of a second; if short-circuited too long, serious damage may be done to the commutator. This operation can not be applied to shunt dynamos, as they will not generate any current when the binding posts of the machine or the outgoing wires are short-circuited. In order to start shunt dynamos, the external circuit must be disconnected from the dynamo, and, after the dynamo has been running at normal speed for about a minute, the external circuit must be suddenly thrown on the dynamo.

Secondly, poor contacts may be the cause. Every connection of the armature and the magnets should be closely inspected. If necessary the contacts should be cleaned and set screws tightened.

Thirdly, the insulation of the binding posts and the brush holders may be in poor condition. For instance, if the metal bars of the brush holders should touch the quadrant, the armature would be short-circuited and no current would be generated. Such faults can be very easily detected by means of the detector galvanometer, as described in Chapter VI.

Fourthly, if one or more field magnets are short-circuited the dynamo will generate current, but the current will not be at normal strength. In this case the dynamo should be examined, as described in Chapter XXI.

Fifthly, shunt dynamos, as mentioned heretofore, will not generate any current when short-circuited. This is especially true for small dynamos. In incandescent lamp installations, for instance, it may happen that two branch wires or two contact points in a lamp-holder, are short-circuited. Even as trivial a fault as this may be sufficient to prevent the dynamo from generating any current at all. By taking out one of the circuit wires and putting an incandescent lamp between the binding posts of the dynamo, it can be very easily discovered whether the fault is in the dynamo or in the external circuit. If the lamp burns properly, the fault is in the circuit. If it does not burn properly, the fault is in the dynamo. If the fault should be in the circuit, insert the circuit wire suddenly in the binding

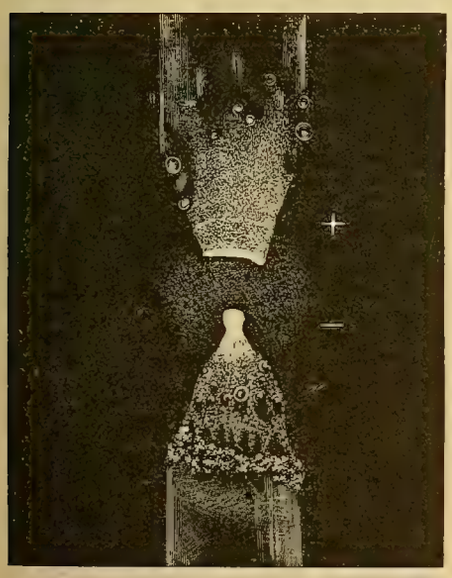


FIG. 17.—ARC LIGHT CARBONS.

post, and the short circuit will show either by burning out or by fusing a safety plug. Great care should be taken in making this test not to set the building on fire, as considerable sparking and often melting of a small wire may be caused in the place where the short circuit is. If the short circuit should be heavy, the probability is that the belt will fly off the dynamo pulley. In such a case the short circuit must be located by means of the detector galvanometer. It is advisable to watch the belt before inserting the wire in the binding post, in order that it may not be injured by being thrown off. If the belt on the dynamo pulley commences to squeak and the lamp between the binding posts commences to burn dimly, the wire should be pulled quickly back again, and this operation not carried any further, but the fault should be located by means of the galvanometer.

CHAPTER XXIII.

Excessive Sparking of Commutator and Brushes.

The causes for excessive sparking of commutator and brushes may be classified as follows:

First, poor condition of the brushes and brush holders.

Secondly, faulty adjustment of the brushes [See Chapters XVIII and XIX].

Thirdly, the surface of the commutator may be rough or covered with dirt and grease [See Chapter XIX].

Fourthly, the insulation of one field magnet coil may be injured and the coil short-circuited in itself. If one magnet is more excited than the other, one brush will spark more than the opposite one, in the same way as if the brushes were not properly adjusted.

Fifthly, two or more segments of the commutator may be short-circuited.

Sixthly, the dynamo may be overloaded. This will cause not only an excessive sparking of the brushes but a considerable heating of the armature and fields. The overloading of the dynamo may be caused by poor insulation of the external circuit, thus causing a considerable amount of current to escape from one pole to the other. Grounding of the external wires, which frequently happens in rainy weather, will bring about the same result.

In arc lighting, lamps may be fed by too strong a current, or in incandescent lighting, too many lamps may be put on the leads.

LAMPS.

CHAPTER XXIV.

Arc Lamps.

When an electric current has passed through two carbon pencils in contact with each other and then separated, an electric spark will jump through the short space between the two carbons and produce what is called the electric arc. In continuous current systems the positive carbon will become more incandescent than the negative and burn about twice as fast. When an alternating current is used the two carbons will become equally incandescent and will be consumed at about equal rates.

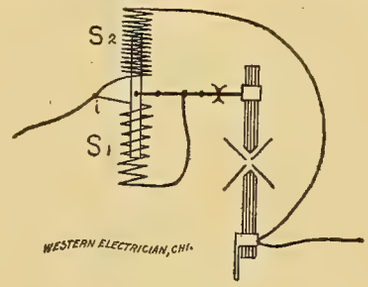


FIG. 18.—SHUNT FOR ARC LAMPS.

In continuous current machines the arc lamps are so arranged that the upper carbon must be the positive, and the lower carbon the negative. The upper carbon will form a little crater and reflect the light downward, Fig. 17. It is very important to have the distance between the two carbons kept uniform at all times, in order to have the lamps burn steadily. The lengths of the arcs of the different systems vary from $\frac{1}{32}$ to $\frac{1}{4}$ of an inch. By the use of dark glasses one can observe the arc without injuring the sight. Systems using the short arc are very often said to employ low tension, while systems using a long arc are said to employ high tension.

Arc lamps with a short arc use a current from 18 to 25 amperes, and an e. m. f. of from 25 to 35 volts, while arc lamps with a long arc use a current of from 7 to 12 amperes, and an e. m. f. from 40 to 60 volts. The feeding mechanism of an arc lamp must keep the arc at a uniform length and allow the positive carbon to feed down at the proper rate. Lamps in which both carbons are feeding towards the arc are called focussing lamps, and are made for the purpose of keeping the arc in one spot, so a projector may be used to advantage.

If more than one lamp is to run from one dynamo a shunt must be provided in the lamp, Fig. 18. These lamps are generally called differential lamps, as the difference between the current strength passing throughout the coarse wire coil S_1, and the current strength passing through the fine wire coil, S_2, operates the feeding mechanism. An arc lamp which is to be run alone from one dynamo has only the coarse wire coil. The current passes from the positive binding post through the coil, thence through a contact to the upper carbon, then passes through the lower carbon and out to the negative binding post.

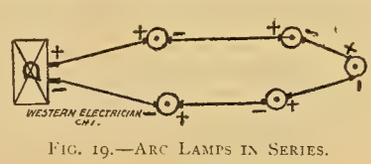


FIG. 19.—ARC LAMPS IN SERIES.

The iron armature or core which is connected with the upper carbon holder regulates the arc according to the increase or decrease of the current strength. If the arc elongates too much the current strength in the coil will decrease, and allow the iron core to drop. On the other hand, if the length of the arc should be too short the current strength in the coil will increase and lift the iron core, thus increasing the length of the arc. Fig. 18 illustrates a differential lamp as used when a series of lamps are run from one dynamo. The lamp has, as described heretofore, in shunt with the two binding posts, a fine wire coil which helps to regulate in the following manner: The current through the circuit must be kept at a uniform strength; if there was no shunt coil an increase of the arc of one lamp would decrease the current strength through the whole circuit and make the other lamps dim. This would cause a permanent fluttering of the arcs and no steady light could be obtained. In using a shunt coil each lamp is made practically independent of the other lamps in the same circuit. If the arc should elongate, the flow of the current through the coarse wire coil will decrease, but at the same time will increase through the shunt coil. This will practically keep the current strength passing from the positive to the negative binding post of the lamp uniform; at the same time a decrease of the strength of the coarse wire coil and a strengthening of the fine wire coil will pull down the upper carbon holder and regulate the arc to its proper length. Each system, of course, will necessarily require certain special instructions which cannot be given here.

Arc lamps are generally connected in series, as shown in Fig. 19. The positive binding post of the dynamo connects to the positive binding post of the first lamp, the negative binding post of the first lamp to the positive binding post of the second lamp, and so on until finally the negative binding post of the last lamp connects to the negative binding post of the dynamo.

An ammeter should be connected in the circuit to show at all times the current strength, which must be kept constant in such a system. The e. m. f. between the binding post of the dynamo will depend upon the e. m. f. of each lamp, and the number of lamps in the circuit. If, for instance, one lamp requires 50 volts, and there are ten lamps in the circuit the total e. m. f. between the binding posts of the dynamo would amount to $50 \times 10 = 500$ volts. Besides the ammeter there is generally a hand or automatic regulator connected in the circuit to enable the dynamo tender to keep a constant current strength in the circuit. If one or more lamps should be turned out, the current strength would increase if properly arranged devices did not cut down the e. m. f. of the machine, and thus keep the current strength at its normal.

CHAPTER XXV.

Suspension of Arc Lamps.

Arc lamps should be securely fastened and properly insulated from the point of suspension. When used outdoors a weather-hood should be put above the lamp to protect it from rain or snow. The wires leading to the lamp should be well insulated in order to prevent their getting in contact with any part of the lamp, except the binding posts. The set screws of the binding post should be well tightened.

If cords and pulleys, or counterpoises and flexible cables are used for raising and lowering lamps it is well to examine all these parts carefully every few months, as ropes and flexible cables will wear out, and the lamps or counterpoises may drop, and bring property and human life in danger. For these reasons it is preferable to have the lamps put up stationary, or devices should be used which will take the strain off the ropes or cables when the lamp is in its place.

CHAPTER XXVI.

Trimming and Cleaning Arc Lamps.

Special instructions are given for each system when the plant is put in operation. The following, however, are general rules which will apply to all systems: In putting in the carbons care should be taken that they are well pointed, and that they are not too long. There should be sufficient space to allow the feeding mechanism to separate the carbons at least one-fourth of an inch. The carbon holders and all other parts of the lamp which are exposed should be dusted off every time before putting in new carbons. The carbons should be cleaned with a clean rag moistened with benzine or spirits of ammonia every day. Contact points and binding screws are to be kept clean and well tightened. The upper carbon, as has been described, will be consumed about twice as fast as the lower one; hence the upper carbon should be twice as long as the lower carbon. Generally the upper carbon is made 12 inches long, and the lower carbon 6 inches long. One set of carbons will last from 5 to 8 hours according to the current and kind of carbons used. Larger carbons will burn longer than carbons of smaller diameter; but generally lamps will burn more steadily with carbons of smaller diameter than with those of larger diameter. Short arc lamps use mostly carbons from seven-sixteenths to one-half inch diameter, while long arc lamps use carbons from three-eighths to seven-sixteenths inch diameter. Carbons should be kept in a dry place.

CHAPTER XXVII.

Incandescent or Glow Lamps.

An incandescent lamp consists of a carbon filament inclosed in a glass globe from which the air has been exhausted by means of an air pump. The electric current passes through the carbon filament, which offers so much resistance that it becomes very hot and glows, or, as we say, becomes incandescent. Most incandescent lamps are made for an e.m.f. of from 50 to 120 volts. Lamps should always be burned at the proper e.m f. If they run above the normal e.m.f., the candle power will be increased, but the life of the lamp will be very much shortened. Incandescent lamps can be connected to the dynamo in various ways; for isolated plants they are generally connected in parallel or multiple arc.

Interesting Experiment.

It is said that Electrician Palmer, of the Town of Lake, is experimenting with a novel device, one by which an ordinary water main may be converted into a telephone. Mr. Palmer has already succeeded in transmitting speech through a main two blocks long, the pipe being full of water at the time. There is not much hope in the inventor's mind that his device will prove of great practical utility, but it is certainly an interesting experiment.

Western Electrician.

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OUR esteemed contemporary, the *Electrical Review*, of New York, has donned a new spring dress in the form of a cover, and takes occasion to utter words of self-gratulation. We cordially wish for our contemporary the prosperity that is due activity and enterprise.

T. CARPENTER SMITH, of Pittsburgh, takes a hand in the discussion of the "Alternating vs. the Continuous Current," now before the Chicago Electric club, in a communication which appears in this issue. He corrects certain statements that have heretofore been made before the club, and does it in the racy but forcible manner which characterize his writings. The communication forms an interesting and valuable part of the literature that has been evoked since the commencement of the discussion of the subject by the club.

BY purchasing the entire motor business of the Van Depoele company, of Chicago, the Thomson-Houston company has added an important department to its immense business. The transfer gives to the Eastern company patents conceded to be of great value, and with its ready capital, the corporation can extend the railway and motor systems to large proportions It is a matter of regret that a business promising so well could not be retained in Chicago, but the transfer is made to a concern which has the enterprise and money to develop it as it should be developed.

THE great storm which visited the eastern states last week and played such havoc with telegraph lines has emphasized the great dependence of every business community on rapid means of communication, in a forceful way that will not soon be forgotten. Business was in a large measure paralyzed and personal inconvenience of the most aggravating character resulted from inability to resort to the ordinary mode of sending messages. The practical utility of the long distance telephone which performed invaluable service when the telegraph lines were broken was strikingly illustrated. That communication was so soon established by shifts of all kinds after the complete demoralization of the service indicated sturdy enterprise and ingenuity on the part of those who make it their business to serve the public in this important department.

THE numerous possibilities of electrical application to the arts is well illustrated by Elmore's new method of manufacturing copper pipes by electrolysis. These applications are on the increase in various branches of metallurgy, as shown by the frequent reference to the new process of electric welding, the electric separation of ores, and other metallic operations.

This new method of making copper pipes is so simple that it is surprising it has not been thought of before; and the only doubt which suggests itself is in regard to its economy. It is very evident that copper can easily be deposited in the manner proposed, and subsequently separated from the mandrel by heat, in consequence of the expansion of copper being greater than that of iron, and also from the more direct application of heat at the surface. But the principal feature of the process is the breaking up of the crystalline structure by which tenacity and homogeneousness is greatly increased; and this would seem to be easy enough of accomplishment by the mechanical method proposed.

Experiments are in progress in Alsace to test the practicability of lighting railroad cars by means of storage batteries placed under the cars. Each battery consists of 36 cells contained in a tray, and they are charged during the day at stations which have an electric lighting plant. The battery has a capacity of 40 ampere hours and the cells are small ebonite boxes, containing the plates, each of which consists of a rectangular lead frame, constructed with a number of vertical lead pencils, ⅛ inch diameter, widened at every half inch into thin disks of about ⅜ inch diameter, forming a grid of pencils and disks which supports the usual active material. The plates are much thicker than those of the usual description. Each car is lighted by five 10 candle, 60 volt Seel incandescent lamps, each equiring .5 to .6 of an ampere. A small rheostat in front of the battery enables the conductor to regulate the light. The illumination is said to be much better than that previously obtained from 5 candle gas lamps.

THE Bell telephone patents have been sustained after years of the most expensive litigation by the United States supreme court. The decision was concurred in by a bare majority of the judges. Justices Waite, Miller, Matthews and Blatchford affirmed the validity of the patents, but Judges Field, Harlan and Bradley voted against the Bell company. In another column will be found synopses of both the majority and the dissenting opinions which are both full of interest. The decision settles the bitter controversy. While it is not proved according to the prevailing opinion that Bell was the original discoverer that articulate sounds could be transmitted over a wire, it has been established that he was the first to make the invention practical and to adapt it to the requirements of the public. He is entitled therefore, the court holds, to the credit and the full value of the invention. The determination of the court is not a surprise and that the finding of the court was surmised is proved by the constant appreciation of Bell stock.

MR. SLATTERY'S paper on the alternating current system, read before the Chicago Electric club, March 19th, will be found in this issue. It is a very plain, practical paper, and without going deeply into abstruse technical points and mathematical details, presents the leading advantages of the system.

Mr. Slattery claims as one of the leading advantages of the alternating system that it is possible on an economical basis to distribute the current over a far larger area than is possible with the continuous current system, so that while the latter requires several central stations, for a comparatively limited territory, the alternating system can cover a wide area from one central station; hence, in large cities, where central property is relatively of much greater value than that on the outskirts, there is great economy in being able to locate a single generating station at a remote point where property is cheap, and distribute the current over central and highly valuable property, rather than locating separate stations on such costly property, which, in a city like Chicago, would require a large investment of capital; this, according to Mr. Slattery, is an important point in favor of his system.

The increased size of copper conductors required to extend the continuous current, with even so excellent a system as the Edison, over an area much greater than a square mile, renders such extension practically prohibitive, and makes the location of numerous stations an economical necessity, while the alternating system can use small conductors to convey currents of limited quantity and high e. m. f., and, having reached remote points, can, by means of transformers, reverse the electric conditions, and obtain the numerous low tension currents required for distribution to consumers, from the main high tension current of small quantity easily conveyed by the small copper mains from the central station.

While both systems are at present earnestly contending for the prize of superiority, and both can show distinctive points of great excellence, it is too early to give a decided preference to either. The outlook for the alternating current transformer system is certainly very full of promise, but it is new and comparatively untried, while the continuous current has long since passed the experimental stage, and comes before the public with a practical experience of ten or fifteen years. Both systems have doubtless their respective spheres, in which each can justly claim superior economic advantages, so that the antagonism may after all be less real than apparent.

THE old theory of the electric origin of tornadoes, which is again presented in a paragraph in the New Orleans *Picayune*, is no longer entertained by scientists, a far more reasonable and satisfactory theory having taken its place Electricity is an adjunct to the tornado, but by no means its main factor. The primary cause of the tornado is the confinement of a stratum of hot air next to the earth's surface, underneath a stratum of cold air, producing the sultry calm which precedes. As this hot air has a lighter specific gravity, its tendency is to rise and force its way through the denser stratum above; finding an outlet at some weak point it rushes upwards with great velocity, expanding as it ascends, and the vapor with which it is charged condensing, forms the funnel-shaped cloud. It has at the same time a horizontal circular motion, always, in our northern hemisphere, from the right to the left of a person standing at its center; this motion is supposed to be derived from the cylone which incloses it and which embraces a large area of perhaps hundreds of square miles, while the tornado does not embrace more than one; the circular motion of the cyclone is caused by the difference of velocity between south to north and north to south air currents deflected by the earth's rotation, giving them a rotary motion always in the same direction. On account of the friction of the earth's surface the whirl of the column of air at the base of the tornado is less rapid than higher up, so that the ascending movement is spiral, and as the air rushes inward and upward towards the central vent above, the velocity attained in the outer gyration increases as the spiral diminishes in the inverse ratio of the square of its radius; a velocity of perhaps 30 feet per second in the outer whirl attaining 300 feet in the inner. The centrifugal force, derived from this immense velocity, tends to create a vacuum in the center into which houses, trees, and animals on the surface are drawn with terrific force, sucked upward, and thrown out from the expanding column above. This gyrating column has also a progressive motion, usually from west to east or north-east, so that the solid bodies which it takes up are carried forward and dropped often at a considerable distance from their original location. When a house is inclosed in the central vacuum, the sudden expansion of the air within causes it to explode, lifting the roof and scattering the contents in every direction; while if farther from the center it may be lifted from its foundations and turned round and at the same time carried forward. For the same reason fowls are stripped of their feathers. It is a great traveling air pump of enormous energy, sucking up everything in its path.

At the same time the friction and condensation produce the accompanying electric phenomena, and the cold resulting from the sudden expansion of vapor produces hail, which is a usual accompaniment.

The descending motion of the snake-like appendage, forming what may be termed the spout of the tunnel, is only apparent; it is the narrow vent through which the hot vapor-laden air first ascends, and where condensation first makes the vapor visible. When this air all escapes, which usually takes place in an hour or less, the tornado ceases with the cessation of the cause which produced it.

Bell Telephone Patents Sustained.

The long anticipated decisions in the Bell telephone suits were handed down Monday by the United States Supreme court. That the patent was sustained was not a great surprise. The cases were considered by seven of the judges, as Justices Gray and Lamar were not sitting. The validity of the patent was sustained by the majority vote of Justices Blatchford, Waite, Miller and Matthews. Justices Bradley, Field and Harlan dissented. The opinion was read by Judge Blatchford, as Chief Justice Waite, who had written it, was indisposed. There are six cases covered by the decision, one of them coming from Massachusetts, one from Pennsylvania, and four from New York. In the first five cases the appellants are Amos E. Dolbear et al., the Molecular Telephone company, the Clay Commercial Telephone company, the People's Telephone company, and the Overland Telephone company. In the sixth the Bell Telephone company is the appellant against the Molecular Telephone company.

The opinion commenced with a review of the question of the scope of the fifth clause of Bell's patent of March 7, 1876—that is, whether the patent was for an art or process of transmitting articulate speech, or merely for an apparatus by which that object could be attained. The court was of opinion upon this point that articulate speech was one of the "vocal or other sounds" referred to in the fifth claim of the patent. Bell discovered that speech could be transmitted by gradually changing the intensity of a continuous electric current so as to make it correspond exactly to the changes in the density of the air caused by the sound of the voice. This was his art. He then devised a way by which these changes of intensity could be made and speech actually transmitted. Thus his art was put in a condition for practical use. In doing this both discovery and invention, in the popular sense of those terms, were involved—discovery in finding the art and invention in devising the means of making it useful. For such discoveries and such inventions the law has given the discoverer and the inventor the right to a patent as discoverer, for the useful art, process, method of doing a thing he has found; and as an inventor, for the means he has devised to make his discovery one of actual value. Bell was the first discoverer of the process of transmitting articulate speech by changing the intensity of a continuous current so as to make it correspond with changes in the density of the air produced by the voice. A patent for such a discovery was not to be confined to the mere means which the discoverer improvised to prove the reality of his conception. The court was therefore of opinion that the patent must be sustained as a patent for a process of art.

In reference to the alleged anticipation of Bell's discovery by Philip Reis, the chief justice said Reis never succeeded in actually transmitting speech, and therefore it was impossible to hold that what he did was anticipation of the discovery of Bell. After reviewing briefly the claims of Dr. Vander Weyde, James W. McDonough, and Cromwell F. Varley, and showing that these claims had no bearing upon the validity of Bell's patents, the chief justice took up the case of Daniel Drawbaugh, of Pennsylvania, and reviewed it at great length.

The effect of the depositions taken to show that Drawbaugh succeeded in using instruments which antedated those of Bell had been completely overcome by the conduct of Drawbaugh, about which there was no dispute, from the time of his visit to the Philadelphia centennial until he was put forward by the promoters of the People's Telephone company, nearly four years afterward, to contest the claims of Bell. He was silent so far as the general public was concerned, when, if he had really done what these witnesses now think he did, he would most certainly have spoken. There was hardly a single act of his connected with his present claim from the time he heard before going to Philadelphia that some one else had invented a telephone which was on exhibition at the centennial, that is not entirely inconsistent with the idea even then of a complete discovery or invention by himself which could be put to any practical value.

The news of Bell's inventions spread rapidly and at once, and it took but a few months to demonstrate to the world that he had achieved a brilliant success. If it were known at Eberly's Mills alone that Drawbaugh had been doing the same things for years in his shops there—and it certainly would been have known all through the little village if it had actually been done—no once can believe that the public would be kept in ignorance of it until four years afterward, when a special from Washington to the Cincinnati *Commercial* announced a telephone combination "to have entire charge of the telephones not only in this country but in the world" that could transmit messages "for almost a song."

The result of the experiments made with Drawbaugh's instruments conclusively show that they could not have done what the witnesses supposed they did, and that what they saw and heard was produced by some other means than an electric speaking telephone. Drawbaugh's defence had not been made out.

The chief justice then took up the charge of fraud and collusion in the patent office, by means of which Bell, it is alleged, obtained surreptitious information with regard to inventions of his rivals and then amended his own specifications. Upon this point the court says:

"We entertain no doubt whatever that the specification as now found in the patent office is precisely the same as that on which the order to issue the patent was made, and the fair copy which is now found on the files of the office is precisely as it was when the order for the patent was granted. Not a shadow of suspicion can rest on any one growing out of the misprint of the specification in the Dowd case."

The chief justice then reviewed briefly the case of the Bell Telephone company against the Molecular Telephone company, which involves one of the claims of the patent issued to Bell on January 30, 1877. The court below held that the fifth claim of this patent was anticipated by the Schellen magnet. Bell's patent, the court holds, was not for the magnet but for the telephone of which it formed a part. To that extent the decree in that case was erroneous. It follows that the decree in each of the cases, so far as it is in favor of the Bell company and those claiming under it, must be affirmed, and that the decree in the Molecular case so far as it is against that company on the full claim of the patent of January 30, 1877, must be reversed and a decree directed to that extent in its favor.

The dissenting opinion was written by Judge Bradley. It is based on a belief that Drawbaugh was the first inventor of the speaking telephone, although he was unconscious of it and was not aware of its importance. Following is an extract:

"There is no doubt that Mr. Bell's merits are very great in appreciating the importance of the discovery, and in bringing it before the public in such a manner as to make it appear to be what it is, one of the most important discoveries of the century. He saw at a glance the importance of it. Drawbaugh did not see it. Had he done so he would have taken measures to interest persons in it with him, and have brought it out. He was a mechanic, a plain mechanic, somewhat better instructed, perhaps, than most ordinary mechanics — a man of more reading; a man of more intelligence. But he looked upon what he made more as a curiosity than a matter of speculation, a matter of financial importance or of importance to the public. That is the way we view his condition of mind in regard to it and explain why he had not taken more pains to bring it forward to the notice of the public. If Mr. Bell, when he applied for his patent, had had in his laboratory the things that Drawbaugh had, he would have been filled with an excitement far exceeding that which has animated the great inventors of the world when they made the discoveries they have made. He would have appreciated it if Drawbaugh did not. Up to the time of making his application for a patent they had not succeeded in producing intelligible speech more than a word or two. If Bell had done at that time as much as Drawbaugh had done according to the evidence, he would have had no hesitation in claiming the greatest discovery that the world has seen in the present century. We have nothing to say deprecatory of Mr. Bell at all, for he has great merits; but we think that this obscure mechanic did do the thing, and that he is entitled to the merit of being the first inventor."

Following is a brief sketch of the Bell telephone litigation: The first important action instituted by the Bell company upon its patents was against Dowd. The latter was defended by the Western Union Telegraph company, and the contest was substantially one between that corporation and the Bell company. The Western Union, owning the patents of Edison and others, began suit against the Bell for adopting their improvements. The claim of the latter company was founded upon the Bell patents of March 7, 1876, and of Jan. 30, 1877. At that time also the telephone instruments used by the Western Union were magnet transmitters similar in form to those of Bell, and not contact transmitters like those of Reis. The defendant was charged with infringing the Bell patent by the use of contact transmitters. The defense was that Bell did not describe in his paper of 1876 any mechanism capable of practically reproducing speech; that he had not then made or perfected any such invention, and that, in view of the early publications of Reis, the bell could not be lawfully construed to cover the transmission of articulate speech, or the method of operation. In the Spencer case the subsequent developments in regard to the invention and experiments of Daniel Drawbaugh, Antonio Mencei and others were not relied upon. In subsequent cases against the People's Telephone company and others the defense based upon the alleged prior inventions of Drawbaugh and others has been supported by elaborate proofs, but in every instance the courts have held that the proofs have been insufficient to establish the fact of any prior invention. In the suit against Dolbear before Justice Gray and Judge Lowell, of Boston, an even broader construction was given to the Bell patent so far as the alleged infringing was concerned than was established in the Spencer. The next case prosecuted was that of the American Bell Telephone company against Spencer in the Massachusetts Circuit Court, which was decided adversely to the defendant.

The most bitterly fought contest over the telephone, was that of Bell against Drawbaugh, the case lasting through several years, and being finally decided by Judge Wallace in Bell's favor. Drawbaugh is a mechanic, living in a small Pennsylvania town, who, some time about 1872, made a working telephone, using a cigar box, a glass tumbler, a tin can and other crude instruments. With this telephone, he says, he carried on a conversation over a wire several hundred yards long, and when the testimony was taken in Pennsylvania, more than a score of persons were found to testify that they had either heard of Drawbaugh's telephone or actually used it. Some instruments said to be the original ones made by Drawbaugh were brought into court and exhibited, and it was shown that speech could readily be transmitted in an imperfect way with their aid. In Drawbaugh's statement it was said that he was too poor at the time to take out the necessary patents, but the other side showed he was not too poor to apply later on for patents upon other devices of comparatively no importance, and he was in communication during these years with men who would have advanced him money to complete anything so important as an apparatus for the transmission of speech.

Gray's claim is that Bell derived by accident or fraud a knowledge of what was contained in a caveat filed by him (Gray) describing a practical and useful form of telephone, a so called liquid transmitter. This caveat was filed before Bell applied for his first patent.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	350	360
Central Union	46	47
Michigan	76	77
Great Southern	30	32
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	62	65
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	68	69

Alternating vs. Continuous Currents.[1]

By M. M. M. Slattery.

A few days ago, when I had the honor of receiving an invitation to read a paper before this club to-night, relating to the alternating system in parallel a c, to be in reply to Mr. Leonard's paper, I felt, understanding Mr. Leonard's proclivities, that the usual stereotyped attack would be made upon a system which has alike elicited the admiration of those who have disinterestedly given the subject some thought, and the most rancorous feeling on the part of those whose business has been placed somewhat in the background by the rapid developments which have taken place in this comparatively new field of electric lighting. In a moment of unguarded enthusiasm I accepted the invitation. As some of you may know, I am practically engaged in the alternating branch of electric lighting, and my time is so much occupied therein as to almost entirely preclude me from having time to either write or read papers. I regret, therefore, that in this short paper I shall not be as comprehensive as I should wish, and will principally confine myself to replying to some of the salient points in Mr. Leonard's paper.

We are told that the following are the sum total of the vital factors in a general supply system of electric energy, viz.:

1st. Cost.
2d. Economy (efficiency and depreciation).
3d. Reliability.
4th. Safety to life.
5th. Variety and value of the possible sources of revenue.
6th. Effects upon existing property.

The factor of distance over which you have to transmit the electric energy is conspicuous by its absence, not being considered of sufficient importance to be enumerated in the list; we shall see presently of what value this factor is. Of course Mr. Leonard, as is customary with advocates of the low tension system, starts out with an explanation of the transcendant merits possessed by the three-wire system, and expresses in the usual terms the 66 per cent. saving over the two-wire system.

In the paper read by Mr. Leonard, elaborate tables of figures are given, into which I will not attempt to follow him in detail to-night. It would only weary you, and, as you are aware, if the premises are once granted, almost anything can be proved by figures. All I would say is, examine those figures yourselves, but do not assume that the data are correct.

It is a very ingenious rhetorical device to take the cost of the Edison system for distribution over a small area, and compare it with the cost of the induction system over a small area, and thus show that, taking price of converters into consideration, the Edison is the cheaper. This is avoiding the question. The chief claim made for the alternating system is that it can reach customers and supply a market that the low tension system never can.

Another point to which I would call your attention is this: Mr. Leonard assumes the cost of copper to be 16 cents per pound; he had to to bring his estimates at all within bounds. Now, we all now that the price of copper is more like 25 cents than 16 cents. The variation in the price of copper affects the low tension system much more seriously than it does us—another point in favor of the induction system. It may be said, "Yes, but you have to use copper wire in your converters as well as your lines." True, but only to a limited extent, the cost of the converter being largely made up of the iron and the labor. The quantity of wire in a good converter is but small.

Another reason why I do not care to take up your time with a detailed discussion of these figures and tables is that the field has been pretty well covered by Mr. Stanley in a paper recently read by him in Boston, and also for the reason that Professor George Forbes, who is recognized as one of our best authorities, has said with regard to the theoretical economy of the three-wire system that "this may suit American financiers, but is not electrical engineering."

Mr. Leonard is not warranted in assuming a thing in order to enhance the value of his claims; he says we may look forward to improvements in the 100 volt incandescent lamp which will result in 30 per cent. reduction in the cost of conductors in the three-wire system. I have been engaged in the manufacture of incandescent lamps for some 12 years, and, as I have to follow the subject up closely, I trust I ought to know a little about the improvements which have been made in the past, and the possibilities ahead for the future, and I find that for the four years just past, very little has been done towards improving, either the life, or the efficiency of incandescent lamps.

A so-called improvement by a well known company, the Edison, has lately been trumpeted in every direction. Why Swan has been making such a lamp in England for some five years, and so could this same company have made them if they only employed methods which are equally within the reach of all. The reason for this recent claim is obvious, it is an off-set to the large number of lamps per horse power, claimed for the induction system. With regard to the claim put forward on behalf of the Edison company of being able to obtain twelve 16 candle power lamps to the horse power, I will not dispute it, but simply say that the gentlemen who was for four years the mechanical engineer of the Edison Electric Light company has, within the past six months, given sworn testimony in these words: "In the direct current central station system, the maximum which, to my knowledge, has so far been obtained, is between six and seven lamps to the horse power."

Now, gentlemen, a 100 volt lamp, such as the Edison, could certainly be made which would run, say 12 to the horse power, yes 15, or 20, but what would be the life of those lamps? In all probability, as far as our present knowledge goes, very brief. I prefer, in a case like this, to rely upon an absolute statement of fact rather than upon any promises or guarantees or possibilities.

[1]Read before the Chicago Electric club March 19, 1888. The second of a series of papers upon the subject, "The Continuous Current vs. The Alternating Current," before the club.

The limit of voltage at which a lamp can be made so as to have a reasonable life has, it seems, been reached in its upward direction at about 110 volts. It was anticipated a few years ago that a high volt, small current lamp was the great desideratum. Scarcely any progress in that direction has, however, been made for some time, as I have just said, and the tendency, in fact, now appears to be the other way, *i. e.*, toward low resistance lamps — say 50 volts to 70.

The continuous current system is far more susceptible to heavier fluctuations than the alternating, owing to the total absence of automatic regulation in the former, and, when it is remembered that the light intensity of an incandescent lamp does not vary as the potential difference at its poles, but in a much greater ratio, it will be readily understood that the fluctuating system has a much more hurtful effect upon the delicate incandescent lamp than the non-fluctuating system. I am supported in this statement by not the opinion, but by facts deposed to by the gentleman referred to. He says: "The usual percentage of loss in the carrying wires of a direct current system is fifteen per cent., and even with this heavy loss the carrying wires attain a stupendous weight. The practical result from the introduction of this loss in the main wires of the direct current system is, that when such a plant is running fully loaded, the e. m. f. at the dynamos, will be fifteen per cent. higher than at the lamps; whereas, when only lightly loaded, difference in e. m. f. at the dynamos and lamps runs down to a much smaller figure; therefore, in order to maintain the lamps at a uniform brilliancy, the e. m. f. at the dynamos must be carefully watched and adjusted to suit the varying requirements of the load, as in the absence of such care the brilliancy of the lamps will fluctuate and give rise to serious lamp breakage. This regulation of the e. m. f. is accomplished partly by regulating the field magnets of the machine and by the introduction of artificial resistance in the main carrying conductors. The attention to secure these results is expensive, and the devices for accomplishing them very costly"

There is another matter in connection with central station arrangements which, it seems to me, disposes of the question of the relative commercial merits of the two systems in a conclusive manner, and that is this: The advocates of the low tension systems admit that as far as actual wire goes, the 1,000 volt distribution is more economical than is the 100 or 200 volt—that is a palpable matter. But, say they, in addition to the danger and other objectionable features of your plan, the cost of your converters is so great as to neutralize whatever advantages you may have in this way. Without going into that point for the moment, it will be seen that the converter itself costs no more whether the current supplying it comes from 1,000 or 10,000 feet away; that being so, the difficulty which stares the Edison system in the face is the practical necessity of picking out for their central station about the most expensive piece of real estate in the district to be lighted. They must be near the center. They say so themselves. On the other hand, with the high tension system, you may have your central station in the outskirts of the town on cheap land, perhaps on a canal bank or railway siding, so as to unload your coal direct into your boiler room, which may itself save many hundred dollars per annum, while the extra length of the comparatively small conductors would be but a bagatelle compared with the real estate investment in the center of the town. That I am not speaking off the book in this matter will be seen when I quote a passage from a document issued by the Edison company, entitled "Information to Agents," and relating to the desirability of centrally locating the station. It is as follows:

"Note: In a given district to be lighted, the best conditions of economy in street installation are fulfilled when the station is located in the center of the district. If the station is moved one-quarter of a mile away from such center the cost will be about doubled. If the station is moved one-half mile away from center, the cost will be about quadrupled. * * * there need be no hesitation in locating it in the most central locality. A few hundred dollars increase in cost of lot will often save thousands in cost of street installation."

Now, as to the lamp, the reasons for the prominence which a 50 volt lamp is at present acquiring are four-fold, namely, cheapness in manufacture, efficiency, reliability, and that while it is the lowest limit in volts that we should allow ourselves (for distributing reasons) it exactly suits the the most efficient construction of converter.

The fewer the number of turns of wire in a converter the better, within proper limits, and, as in a 50 volt converter we have only half the number of turns that we should have in a 100 volt, the advantages of 50 volt lamp for our purpose will be apparent; the fact also is that, while the manufacture of the 100 and 110 volt lamp has received the greatest attention by manufacturers for obvious distributing reasons, the 50 volt lamp has received comparatively little notice, not being recognized as a factor in a general system of distribution.

The Fort Wayne Jenney company are now making a 40 watt 16 candle power 50 volt lamp. This lamp could just as well have been made long before this, but there was no such demand for it as now exists. If such improvements as Mr. Leonard predicts for the 100 volt lamps are likely to take place and the ratio of the present efficiency of the 100 and the 50 volt lamp holds good, we might look forward to a corresponding increase of efficiency which would enable us to reduce the cost of our converters in nearly the same proportion, that is to say, the cost of a 40 lamp converter would be very little more than for the present 25 light. There would also be the proportional saving in the cost of interior wiring.

Much has been said and written by the opponents of the induction system about the respective first cost of an induction installation and a low tension continuous current installation, viz.: that the low tension is cheaper for very short distances. This sounds very much like a man who had a continually growing business and required an engine, saying that a small engine was cheaper for him than a larger one, because the smaller engine just then met his requirements; after a little time he finds it necessary to dispose of his small engine at a considerable discount for a larger one that will be more adequate to his growing needs. Why not put in at the first that system which will meet any and every illuminating requirement for all time, both at points near to and remote from the source of generation.

I do not know whence the information has been derived, but the theory does exist that with the reduction of the load in the multiple arc induction system there is not a proportional reduction of the energy supplied to the circuit, and that consequently the loss of energy in the line does not decrease proportionately with the load. While this theory would and does apply to a series system of transformers it does not apply to the multiple arc induction system, the latter standing in the same relation with regard to the energy supplied to each circuit as the low tension multiple arc. Upon another occasion I trust to have an opportunity for bringing forward mathematical deductions and power curves incontestibly proving this fact.

No doubt a system cannot be considered a reliable one unless you are able to multiple arc your dynamos; well, we are able to do this. It used to be regarded as difficult, but, with a great many of these apparent difficulties, we need only to understand their nature in order to overcome them, and although at the present moment we can not couple as many together as we should wish, I venture to say that by the time such necessity arises we should be ready to meet it. It is stated that we can not multiple arc dynamos economically. as occasionally one dynamo will shift the load and the other dynamo not only will take it but will try to drive the other as a motor. In an incomplete system this is just what takes place, but in a complete system when any such irregularity occurs, a device is brought into operation that regulates the speed of the engine when any variation therein is inclined to take place, thus maintaining the speed of all the dynamos coupled in multiple, and their potentials uniform, and, consequently, an economically working system.

A good deal has been said from time to time as to the dangers of the induction system, and notwithstanding the repeated exclamations and statements of those who are acquainted with alternating currents and their use, yet only a week or two ago Mr. Leonard in his paper read before this club attempted to resuscitate this scare, which we supposed had been forgotten. Professor Elihu Thomson has publicly stated that he has taken a 1,300 volt alternating current without serious inconvenience. I have myself, as have several of my friends, taken 1,000 volts, and in all the cases with which I am acquainted nothing more than some temporary discomfort followed. The most serious case of which I ever heard was that mentioned by Mr. Carpenter Smith, at the Boston convention. In that case the man was not permanently injured, although under the influence of the current for quite a considerable time, Although I would not go so far as to recommend the use of the 1,000 volt current as a morning beverage, yet it is absurd to let the impression go abroad that it is necessarily or even probably fatal. We recognize the fact that an electric current of 200 volts is less dangerous than one of 1,000 volts; of course, we know that. Does it, however, follow that we shall throw to the winds every advantage that this higher pressure gives us? Because a buggy is less dangerous than a locomotive do we therefore abandon the railroads? Because an arc light system requires more pressure than the low tension are we therefore to abolish every arc light in the country? These question answer themselves. So in time will the other, and "those who came to scoff remain to pray."

As evidence of how safely we can work with the induction system we find that there is nothing to prevent us placing our lamps upon existing gas fixtures, unless it be ignorance, or not employing the proper precautions to render the work absolutely safe. It is suggested by some that in order to prevent the high tension primary current being dangerous to life, in the event of a leak between the primary and secondary coils taking place, to ground the secondary; that if a leak took place from the high tension circuit to the low tension circuit, and there happened to be a ground somewhere else on the primary circuit, no harm whatever could occur to a person taking hold of the terminal of an incandescent lamp, and at the same time touching a gas fixture. While this arrangement makes the use of the lamps by the customers absolutely safe, it subjects the entire system to a strain on the insulation, which I don't think is quite wise, and, instead of grounding the secondary, I think the better plan would be to ground a sheathing of metal, interposed between and carefully insulated from the primary and secondary. So far as safety to life is concerned, this is just as good, but has the recommendation of not subjecting the insulation throughout the system to any strain whatever, and has been used for some time with satisfactory results in the converters made by the Fort Wayne Jenney Electric Light company.

A charge laid at the door of the induction system is that of reliability, and a few small breakdowns which have occurred are exaggerated to a considerable extent by those interested in other systems. Such matters are liable to occur in all new installations, the Edison not excepted. They are simply indiscretions, errors of youth, and not faults of the system as such. In a very short time the experience we have gained in this respect will bear due fruit, and it will be found that the induction system will be just as reliable as the continuous system. In the absence of gross carelessness there is no reason to the contrary, and, indeed, down to the present time accidents have been rare.

With regard to an alternating current dynamo of 1,000 volts being more liable to burn out than a low tension continuous current dynamo of 110 volts, and that the depreciation of the latter is less than the former, this seems to me to be nonsense. Understanding the nature of the work that a dynamo has to do, and with proper experience in construction, there should exist no reasonable doubt about making one dynamo to work as reliably as the other. This is purely a mechanical matter and the ingenuity of our mechanics is equal to any such emergency as that, and, as to depreciation, I venture to say, in fact, I know, that

the armature of an alternate current dynamo of the kind I have had any experience with at full load, does not arrive at anything like the temperature a low tension Edison dynamo does under the same conditions, and we all know what high temperature in a wire has to do with the deterioration of its insulation. Furthermore, by reason of the small quantity of wire necessary in the armature of the alternate current dynamo, we can afford to occupy more space and thereby have less crowding of the wire; thus we have an opportunity of increasing our insulation in proportion to the e. m. f. required, and yet keep within the limits of great compactness. For instance, in an 80c-light machine made by the Fort Wayne Jenney Electric Light company, there are only 20 pounds of wire on the armature.

There has been some little uncertainty about the action of converters in respect to the fuses inclosed in the converter box frequently and mysteriously melting. This, however, I find is attributable to the temperature of the converter at full load not being calculated as a factor with the current for the melting point of the fuse, and I think it will be much better for us to be satisfied with an external double pole fuse at the point of junction of the primary coil with the primary line, and a double pole fuse on the secondary circuit as close to the converter as possible; this arrangement thoroughly protects the system, and a possibility of the failure of the converter becomes a very remote one.

It is said that the operating of motors by alternating currents is not a success. Well, it may be admitted that at the present time the commercial operation of alternate current motors has not attained very large proportions, but who is presumptuous enough to say that, when the present systems of alternate current supply are as old as the continuous, there shall not be as many and as satisfactory motors running on alternate currents as on continuous? Is it for any gentleman connected with the Edison company to stem the tide of invention, to say that the acme of perfection is reached in the triune system of that august body, and to thunder forth electrical excommunication on all heretical expounders of the faith? I trow not. Alternate current motors have been made which have in them the elements of success, and the subject is daily attracting more and more attention from some of our most talented workers in that direction, both practical and theoretical, as examples of which I may mention the valuable papers read quite recently, by Dr. Louis Duncan, before the American Institute of Electrical Engineers, and the earlier one read some months ago by Professor Elihu Thomson, with which no doubt most of you are familiar. The mere fact that motors will work with an alternate current is, of course, well known. The difficulties have been in the regulation. But a difficulty, gentlemen, is merely a thing to be overcome. That is what the difficulties are for. These will be overcome, as have so many others in the grand field of electrical progress. Why, I remember hearing Dr. Werner Siemens say with his own lips that it was hopeless to expect to make a dynamo with a higher efficiency than 50 per cent. He lived to see himself mistaken, and perhaps others may do the same. "Not ten years ago the divisibility of the electric light," as it was called, was ridiculed as the chimera of an enthusiast's overheated imagination, and, nevertheless, where are we to day?

The objection to the induction system on this motor question is based on the assumption that it is a desirable thing to operate motors on the same circuit as lights. Now, although at first sight this would seem to be the case, and although I am not prepared with any formal objections to that course, yet I do know of one company that has been running motors on the same circuit as lights, but are now running a separate motor circuit instead, in addition to their lighting circuit. So that there is such a difference of opinion on the question that it can not be fairly disposed of by any *ex-cathedra* utterances of the advocates of any particular system.

One curious fact, which I think it not very generally known, though the information is public property, would seem to show that the Edison company do not regard the alternating systems as such insignificent opponents as they would have us believe. The advocates of the Edison system profess to regard all these induction high tension systems as inferior to their own, and as almost beneath contempt, yet, singularly enough, I find that twelve months or more ago the Edison Electric Light company of New York, thought enough of one of these systems—a European one, the Zipernowsky—to acquire the exclusive rights in North America to use all the patents on that system, and to obtain certain privileges with regard to those patents. To say the least, it is strange that a company should be willing to negotiate for so worthless a system as they pretend it is. Does it not rather show that they are more frightened than they say, and are providing for themselves a *locus penitentia?* I think it does.

It may be considered that my remarks sound like a direct attack upon the Edison company's system, but I have frankly admitted wherein the induction system is weak, and only claim such advantages for the latter as are warranted by fact, and when we know of cases where, after large installations have been put in and paid for, such, for example, as that of Tyrone, Pa., the investors found upon careful consideration of the question, that they could make more money by setting aside their original investment and change over from low tension continuous (three wires at that) to high tension induction, that I have not spoken too strongly. But, gentlemen, whatever I or anybody else may say in favor of one system and in condemnation of the other system, will, from a commercial point of view, affect the subject in dispute very little, and we may rest assured of one thing, that the public at large, whose business it is to study these questions, have discrimination enough and practical knowledge sufficient to enable them to make a wise selection. The respective systems, low tension continuous and high tension induction, are now before the public, and the ascertaining of their respective values is within the reach of those who desire to know them; they will perceive that claiming that a thing can not be done does not settle the question, for they will see it being done, and the great question of the public will be what does this cost? What profit can I make upon my investment? Be confident that the public will not go far wrong when the information it seeks is placed within its easy reach.

Chairman Brown called for a discussion of the paper; but before remarks were made H. Ward Leonard moved that a vote of thanks be extended Mr. Slattery and that his paper be accepted and placed on file. Mr. Sperry seconded the motion and it was passed unanimously.

MR. SPERRY, after some delay said he thought that Mr. Slattery could congratulate himself on having covered the ground so thoroughly that no one seemed to have anything to say. He had not seen fit to change his views regarding the value of the alternating system since the last meeting of the club and could be considered a firm believer in it yet. He had had a hope however that Mr. Slattery would have some mathematical developments to present with regard to recent improvements in the alternating system and felt somewhat disappointed that the matter had not been discussed in that direction. He felt gratified that the commercial phase of the alternating question had been pronounced so satisfactory and regarded that as a fair index of what could be expected of it in the future.

The statement was made that the converter was the better for the fewer number of convolutions of wire in it "I fail to see how that would bear upon the case materially. I can see how the number of convolutions might affect the cost of labor somewhat."

MR. SLATTERY said he owed an apology to the club He had been announced to read a paper upon recent developments in the alternating system, but a few days after receiving the invitation Mr. Leonard's paper read at the last meeting of the club had been called to his attention and he had turned aside to answer it. At the present moment I am engaged in carrying out some careful determinations with regard to the induction snstem. I have not got the data at present but I anticipate having it ready in a few days and hope to have the opportunity of entering upon it fully before the club.

"You are all familiar with armatures of the alternating current type and are aware that the greater the number of convolutions of wire the greater the reactive effect. The same law holds good to a very much higher degree in the operation of the converter and that is why we keep the number of convolutions of wire in the converter as low as possible.

"I consider a 1,000 volts about the limit to which we should go and am all the more influenced in arriving at that conclusion on account of the insulation we have to have."

Mr. Haskins, in regard to the dangers of such high voltages, said he had written to Dayton, Ohio, to ascertain the particulars of the accident which Mr. Burroughs of the opera house in that city had sustained. The newspapers had stated that by the crossing of the telephone wires by the electric light wires Mr. Burroughs, when answering a call at the telephone, "had received a shock which had nearly proved fatal. It was also stated that the instrument at the time was enveloped by a bluish flame. A letter which Mr. Haskins had received characterized the whole story as nonsense. The truth of it was that Mr. Burroughs was standing with his fingers on the binding posts of the telephone when some one rang up the opera house. He had received a very slight shock. There had been no crossing of wires. In fact Mr. Burroughs was quoted as saying that the whole story was more absurd than anything he had ever read in the papers and "that was saying a good deal nowadays."

MR. SPERRY had noticed at Pittsburg that the insulation upon the primary wire was much heavier than that upon the secondary and was rendered water-proof. He had also noticed that everything had been done to make the primary circuit as perfect as perfect as possible.

MR. SLATTERY: I would like to refer to a note from Professor George Forbes whose researches have been of the most exhaustive character, To-day his writings are a guide to us in the obscure paths of electrical science.

[The appended letter was then read:]

"I am sorry that I am not able to be present at the reading of your interesting paper in which you discuss the relative merits of continuous and an induction system of electrical distribution, I have read your paper with great interest and I feel sure that your conclusions willl meet with general acceptance by all those who are capable of forming a judgment on the subject.

"There is one point on which I may perhaps be permitted to express an opinion. An objection has been raised to the alternate current in a system of distribution on the ground that it is not applicable to motors. I confess that it is unwise to make a positive statement on purely theoretical grounds, but I have no hesitation in publicly stating the fact that if an ordinary continuous current motor be made with laminated field magnets it will work with alternating currents economically and efficiently and at any required speed.

"I feel some diffidence in making an *excathedra* statement of this kind but the matter is, I believe, of such vital importance at this present time that I am anxious to make use of any weight my statement may have to dispel the illusion which I notice is very prevalent that motors cannot be successfully run by an alternating current."

GEO. FORBES.

MR. LEONARD: I confess to a little disappointment myself in that the principal points of the paper I presented were not discussed to a greater extent—the comparative first cost within ordinary ranges and the comparative efficiencies—so that a comparison of the systems as they are met in common practice might be instituted.

The figures presented were of very simple character and in a few minutes could be thoroughly criticised. Everything was clearly stated and if there is anything incorrect in the figures it certainly would have been a good strong point to have brought it out in connection with other points and might show that the alternating system was preferable.

Of course during the present corner on copper, the prices are unfavorable toward any low tension system but that the prices resultant from the corner on copper will be maintained through a number of years I hardly think is a ground that should be taken. As to the opinion of certain English scientists on the question of saving in the first cost of the three-wire system over the two wire; it has been frequently stated that the maximum saving of the three-wire system is 25 per cent. and that any further saving in copper beyond that was not a fact and that it was altogether chimerical. The fact is that the saving is 66 per cent.

Mr. Slattery has quoted my expression, which by the way was quoted from another, as to the "dragging" of one alternating machine by another. I had no intention of intimating that one machine was dragged by another and I do not think that any one will imagine I attempted to convey the idea that one machine was actually dragged by the other. Of course one machine would be operated as a motor and yet the term might be employed as the first machine was doing work in making the other go forward.

The point of comparative depreciation of the plant was not, I believe, mentioned: That strikes me as one of the fundamental elements.

The reliability of operation, which strikes me as a matter of the deepest concern, was not touched upon.

As my paper was based almost altogether upon the figures presented, and as these figures have not in any way been met or criticized, I hardly feel that the vital points can be discussed except by taking them up.

PROF. BADT: As I have to read a paper on this subject in about four weeks I do not care to enter the discussion, but will content myself with one statement, and that is I regret very much indeed Mr. Slattery draws the line at 1,000 volts simply because he does not trust our insulating friends. In some stations 1,800 and even 3,800 volts are employed Either they must have better wire, or else the curse of the age, undertakers wire still clings to us. I think there is no necessity of stopping at 1,000 volts. If other people go beyond this, I don't think we need stop, and our insulating friends will have to get ready for us.

MR. BARCLAY asked if Prof. Badt was prepared to pay the price for good insulation?

PROF. BADT: We are prepared to pay for any good insulation when we are asked for it.

MR. SLATTERY: Mr. Leonard criticized me for not referring to his figures, and at the same time states that I referred to them in such a way as to intimate a doubt as to their correctness. If I had had the time I should have been very much pleased to have gone into the details. I said I would be glad of an opportunity of meeting the club on another occasion to prove the numerous inaccuracies with which Mr. Leonard has treated us. I think I touched upon each of the points presented by Mr. Leonard, although I did not go into them as comprehensively as I desired. I did not refer to the converters because I have not been able to ascertain any commercial depreciation in that particular branch of our work, which has extended over a period of two and one-half years. Two months ago I had occasion to take to pieces a converter that had been in use that length of time. Believe me, sir, I discovered no evidence of deterioration whatever, and I was one of the most gratified men you ever saw. There has been a theory in existence that the alternating current has a deteriorating effect upon the copper itself. These are theories, gentlemen.

MR. CUTTER: In relation to the general depreciation of the plant; I think I appreciate the point Mr. Leonard presents and asks us to compare $1,000 worth of copper twenty years hence with $1,000 worth of converters twenty years hence. This matter can well be brought before us by merely making a mental picture of an aerial circuit for the Edison three-wire system and a converter system—a picture of the poles with the wires on board and everything ready for operation. Now let us ask any practical man which he would prefer to maintain for twenty years. A pole line all over town of many wires of different sizes, feeders and mains and neutral wires or a pole line of the converter system with possibly two, possibly four circuits if it happens to be for 2,500 lights. With the latter system the poles will be lighter, the wires lighter and the construction of the whole lighter. The depreciation of that plant is not the relative depreciation of the bare copper. The converter itself is so made that it can be taken to pieces and removed without adding very greatly to the cost of the copper wire which is put on The cost of the transformer was chiefly manual labor, that is putting the thing together, therefore if we have to rewind a converter we slide the cover off, pull off the silk insulation and the copper we pull off is worth just as much as the copper in the Edison three wire system.

The common practice in this country in the alternating system is to employ about 1,000 volts. On the other side of the water we find 1,800, 2,500 and even 3,000 volts employed but if we glance at the figures we find that the wire even at 1,000 volts is a small item and although we gain somewhat in using 2,000 volts we add to the insulation and mechanical skill in putting the circuit up.

Of course we have had some experience with the depreciation of the alternating dynamo and have had armatures that burned out; but I believe that the causes of the armatures burning out were chiefly mechanical. One of the first armatures we made burned out, but the armature was made of disks of thin iron held together by bolts passing through them. The motion of the machine worked one of those little bolts of iron loose and it cut through the insulation and caused the armature to burn out. This did not necessarily indicate a defect, theoretical or practical. There are other points, of course, which can be learned by experience.

I would like to call attention to another point, that is grounding the secondary wire. The idea was advanced by Professor Elihu Thomson and we practice it to some extent to day. We think it best to ground the secondary wire, trusting to the expert service to make the primary safe. The only danger in this case that is liable to occur

is, of course, the blowing out of some of the fuses. Therefore, if we ground the secondary throughout the system, it is impossible to get more than a fifty volt shock by touching the lamps anywhere, thus making the system entirely safe to the consumer.

Professor Badt asked Mr. Haskins what he was going to test when the secondary circuit is grounded.

Mr. Haskins replied that it was said that God took care of His chosen people and he did not doubt that when the time came for him to test such circuit some way would be indicated to him.

Messrs. Slattery, Cutter and Warner then entered upon a discussion, of the point whether a sheath connecting to ground interposed between the primary and secondary, relieved the strain on the insulation of the wire in either primary or secondary.

Mr. Slattery affirmed that it did and the other gentlemen held that it did not. Prof. Badt raised the objection that the discussion indicated a war in the camp of the allies, whereas the discussion was between the alternate and continuous current. The discussion was then brought to a close and the club adjourned to meet again Monday, April 2nd.

The Alternate vs. the Continuous Current.

To the Editor of the WESTERN ELECTRICIAN.

PITTSBURGH, PA., March 15. In your issue of March 10th, I find reported a paper read before the Chicago Electric club on March 5th, upon "The comparative value of the continuous and alternating current systems, for the commercial distribution of electricity," by Mr. H. Ward Leonard, in which paper, and in the discussion which followed it, some statements about our system here were made, which I desire to correct.

I do not intend to argue as an advocate of the alternating system; I have done enough in that direction at the electrical conventions. I only wish to correct false impressions which concern me individually as superintendent of this work.

Mr. Leonard speaks of the death of a telephone operator in Pittsburgh. This is simply not so. There has been no telephone operator or any one else in Pittsburgh killed by the alternating system. The instance to which he refers, and which has probably been misrepresented to him, was the stunning of one of the girls in the telephone exchange by a shock from one of the magneto bells used for calling subscribers. Surely Mr. Leonard does not therefore desire the telephone taken out of the house as a deadly menace to the lives of our mothers, wives and children.

We have a great many cases where we are operating 100 volt and 50 volt lamps from the same converter, though not necessarily on the three-wire system, but we have run 100 volt lamps on 50 volt converters, by putting the secondary mains in series, and the 50 volt lamps on 100 volt converters by putting the primaries in series; in fact, it is possible to obtain almost any combination with converters, which is in itself a very great convenience.

Mr Leonard was "impressed" by our carrying a spare armature for our five large dynamos. We do. We also carry a spare armature for each size of our direct current machines, and several spare armatures for our arc machines. We also carry spare connecting rods for our engines, spare straps, brasses, keys, piston rings, etc., and spare tubes for our boilers; and so, I think, should every superintendent who has 15 000 lights on his conscience.

It strikes Mr. Leonard as being rather odd, that in the "home of the alternating system" we should find it necessary to establish two stations. Our company established, not two, but four stations, and why? Because with no practical continuous system could we operate our lights at the distance required. The first effect of the introduction of the alternating system was to completely wipe out one of these stations, of 1,800 lamps of 16 candle power each, and to operate the whole from our central station. Will Mr. Leonard tell us how he would do this with the three-wire system, the distance between the station and center of distribution in the building being 3,000 feet, and all the lamps burning at once, twelve hours per night? The second effect of the introduction of our alternating system is the stopping during part of the time of a second station of 1,500 lights average load, with the near prospect of its permanent shut down, and the removal of the machinery to our general station, the distance in this case being 13,000 feet from station to station. Will Mr. Leonard tell us how he could run this on the three wire system?

The only reason that we do not contemplate the shut down of the third station is that "Station A," where we have established our business office, is in the center of the city, and we can not get room enough to put in the necessary power. We shall accordingly use "Station B" simply as a generating station, one mile from the heart of the city, and shall bring over from that station the necessary current for 10,000-16 candle power lamps, distributing it from our central station, Station A. Will Mr. Leonard tell us how he would tackle this case?

Mr. Leonard quotes very extensively from English electricians. I am a "Blarsted Britisher" myself, and do not hesitate therefore to remind Mr. Leonard what he surely heard Prof. Forbes say at the Pittsburgh convention, that "In England they know very little about the alternating current system as compared to what is known here in America."

With regard to the danger of a connection between the primary and the secondary, does Mr. Leonard mean to say that a revolving armature with two windings on it side by side, which his description would seem to imply, is safer than the two stationary coils entirely separated from one another and from the iron core and case by mica, insulating tape and air space, which constitute the alternating converter?

Mr. Leonard says "I do not consider that the lamps, as as they existed in that station at those long distances, were any more liable to be continuous than in the case of a series system, which of course can be operated at the same distance, and probably with equal results." The lamps, as they existed, were simply run from the second station, which has its dynamos shut down, and its bus wires, by the closing of a double pole switch, charged with current from our main station. Will Mr. Leonard tell us of a series system in which the individual lights can be cut off at the sweet will of the customers, with a corresponding decrease in current from the station?

I do not intend to enter into the question of the first cost of converters, as against the cost of copper, etc., with Mr. Leonard. By the use of the alternating system we are enabled to rent lights at a distance from our station of from two to three miles. As a consequence, without a single attempt at canvassing, we have increased our lights in eight months from 4,000 to 15,000 lights of 16 candle power each; in one case, 1,800 lights in one building, 3,000 feet from the station; in another case, 1,200 lights 2,000 feet from the station; in another case, 800 lights 2,400 feet from the station; and on the same feeder, 300 at 12,000 feet from the station—all with less than 6 per cent. loss under full load from switch-board to lamp. Add to this that we can operate all of these from our Station B, 5,000 feet further away with only 5 per cent. additional loss. When Mr. Leonard has shown a case where a station operating the three-wire system has taken such contracts, *and stand ready to take them at any minute*, I shall be glad to discuss the commercial side of the matter with him.

I have not asked Mr. Leonard to answer any questions based on "average distribution over a radius of x feet" (all of which planning is very pretty on a map, but very little average distribution has ever come my way), but have placed before him certain cold blooded every day problems which we have solved, without any trouble, by means of the alternating system.

I am sorry to have taken up so much of your space, but as superintendent of this company, I do not care to have it appear that after having used the direct current system, I should recommend any system which is not as practicable and economical.

T. CARPENTER SMITH, Superintendent,
The Allegheny County Light Co.

The Bell Company to the Rochester Ex-Telephone Subscribers.

At a meeting of the executive committee of the Rochester, New York, People's Telephone association, March 16th, the Bell Telephone company of Buffalo, presented the following propositions prefaced by the accompanying self-explanatory letter:

F. J. Amsden, Secretary People's Telephone association, Rochester, N. Y.:

DEAR SIR: Replying to your letter of February 27, 1888, enclosing memorandum of agreement, etc., the executive committee of the Bell Telephone company, of Buffalo, to whom it was referred, respectfully submit the enclosed answer, which they trust will meet the approval of the majority of your association.

Very truly yours, H. M. WATSON,

Chairman executive committee of the Bell Telphone company of Buffalo.

Taking the propositions contained in the memorandum of the People's association of Rochester, in their order, the executive committee of the Bell Telephone company of Buffalo desire to say:

First proposition — This proposition has reference to the appliances (poles and underground conduits) by which its business shall be conducted, and the matter is now before the common council of Rochester upon the petition of this company, as follows:

To the Honorable, the Common Council of the City of Rochester:

The Bell Telephone company of Buffalo respectfully asks permission to construct conduits under and through the streets and alleys of the city of Rochester for the purpose of laying its wires underground, and would specify that if permission is granted, it is proposed to construct at least one-half mile and probably one mile of such conduits the coming season, to be followed by a like amount each year until at least three miles of such conduit is constructed.

The company offers to provide one duct in all conduits laid — *i. e.*, sufficient accommodation for one hundred wire cables to the city of Rochester for its wires, free of charge, and will give satisfactory security to indemnify the city against possible damage occurring to the streets or to the city otherwise, in consequence of said construction. Very respectfully yours,

(Signed) H. M. WATSON, President.

It is hoped and presumed that the common council will take such action in relation to that petition and make such reasonable regulations touching such appliances as are required by the interests of the city and shall be just toward the petitioner. It is not thought best to complicate the subject by contract with any one but the city.

Second proposition — This company has lately issued a circular to its old subscribers in Rochester offering to contract for telephone service on the flat rate system, to which system it will adhere.

Third proposition — The subject of this proposition has been considered sufficiently in above reply to the first proposition.

Fourth proposition — The association can not and does not agree that a single subscriber will resume relations with the telephone company by renewing his contract, and we can see no reason why we should give up $12,000 of claims which we consider good and which, so far as the courts have passed upon them, have been decided to be good, without any consideration whatever. We promise in our circular of February 14th, to rebate all our old account against any former subscriber, provided he enters into a new contract at the prices named in the circular on or before the first day of March. The following is an extract from the circular:

Single lines.		Combination lines.	
Business	$64.00	Business	$57.90
Professional	54.90	Professional	46.00
Residences	45.00	Residences	40.00

The above prices are for all subscribers within one mile of the central office. Mileage will be charged for all points beyond one mile, at the rate of $20 per mile, except on combination lines when each subscriber will be entitled to one mile of wire.

We are willing to extend the time for old subscribers to renew contracts to May 1st, our position being this: We will reinstate all subscribers, who went out November 20, 1886, in the same position they occupied at that date. Making a new contract at the above rate rebating all claims against them since that date, and credit on new service their advance payments. This is as far as with any show of reason we can be asked to go, and it being mutually desirable that the exchange be restored, this policy seems wisest for all concerned. This company has not at any time supposed or intended that any broader concessions should be made by it on this point, than as stated above.

Fifth proposition — In order to an amicable adjustment of our differences, we are willing to pay the costs and such reasonable counsel fees as we may agree upon in the suits now pending. As to the clause in this proposition:

"The company to pay the reasonable charges for the services and counsel of the members of the law committee of the association, in respect to legal matters arising out of the contest between the subscribers and said company since October 1, 1886." We can not consent to pay other counsel fees than in the pending suits.

Sixth proposition — As already stated we have fixed a flat rate for our charges and the prices charged are the same as noted in your sixth proposition, and that proposition contains a statement of the policy that this company intends to pursue in relation to its service and charges.

Seventh proposition — While this company earnestly desires to reach a complete as well as an amicable settlement of the differences between it and the members of your association as is evident from its yielding the only point out of which those differences have arisen, it does not deem it necessary to confer with the law committee of the association as to any contract. As already stated this company has returned to the flat rate system; it is ready to rebate old accounts and apply advance payments to future service, as stated above (in reply to proposition fourth) and to close the litigation and pay costs and counsel fees, as above. It will submit to all lawful and reasonable regulations upon its appliances and service that are imposed by the common council, and will endeavor to give the citizens of Rochester satisfactory telephonic service.

We respectfully submit that this is all that can be asked of us and that if the association are of the same opinion, no further professional legal service is needed by either party except to enter discontinuance of the pending actions.

(Signed) H. M. WATSON,
Chairman Executive Committee.

Buffalo, N. Y., March 13, 1888.

CORRESPONDENCE.

New York Notes.

NEW YORK, March 17.—For the first time in the experience of this generation New York has been obliged this week to suspend business, on account of a blizzard, one of the kind which is occasionally heard of from other parts of the world but which is never looked for in this climate. Communication with the outside world, except by cable, was entirely stopped, and at this writing, five days after the opening of the storm, much expensive repair work remains for the telegraph and telephone companies, and all business is taken subject to delay. The Metropolitan company have employed from 300 to 600 men replacing wires and poles, and the extent of the damage may be judged from the fact that this morning only about 65 per cent. of their wires were working. The lines of the long distance company, which are new and which are built in the most approved way with the best materials, suffered the least of any. It is a notable fact that enterprising newspapers in New York and Boston communicated with their correspondents by way of London, using the Commerial company's cable. The wires landing at Coney Island come underground to the New York offices and were not disturbed. The telephone companies have permission to work to-morrow, and it is expected that by the middle of next week all wires will be straightened out and the instruments working as heretofore.

In this connection the following press despatch is interesting: "The practical value of the new system of telegraphy, by which messages can be sent from moving trains, has been well illustrated by its workings on the Lehigh Valley railroad since the great blizzard of Monday. On account of the severe storm and high winds the regular telegraph lines were all down, but, owing to the forethought of the management of the Lehigh Valley railroad, another line, different in construction and entirely different in its mode of operation, has been in use upon the New Jersey Division, from Perth Amboy to Easton, for several months past, and it proved of great value to the road. In the accident near Three Bridges on Wednesday afternoon, the induction train telegraph operator was on hand and at once telegraphed back to Flemington for a wrecking train. Within a short time Superintendent Donnelly arrived, and during the entire day messages were sent to and from the wrecking train and surgical relief was obtained. All the beleaguered passenger trains, every one of them being equipped with the new system, were located by means of train telegraphy, and provisions were sent to the hungry passengers. Belated travelers sent despatches to anxious relatives from the various stalled trains, and all the manifold business of railroading was carried on with celerity. More than 200 messages were sent back and forth over the single line of the company during the last three days. The poles used to carry the line are only sixteen feet high, and they expose little surface to the storm."

The fact that several railroad accidents occurred during the storms and that coaches caught fire has emphasized the necessity of lighting cars by electricity and heating them by steam. The practicability of these modes of illumination and heating have been time and again demonstrated. These methods would diminish the dangers of fire to a minimum. There has already been discussions of possible means of preventing the repetition of the inconveniences caused by cessation of rail communication incident upon a great storm. It is a fact, perhaps an unfortunate fact, that railway accidents are much more frequent than blizzards, and it is of greater importance that the consequences of the former dangers be guarded against.

Chas. A. Schieren & Co., report recent sales of leather link belting as follows for use with dynamos: Virginia Electric Light and Power company, Richmond, Va.; Rock Island County Brush Electric company, Rock Island, Ill.; Narragansett Electric Light company, Providence, R. I.; Morristown Electric Light and Power company, Morristown, N. J.; North Adams Electric Light and Power company, North Adams, Mass.

Mr. W. H. Eckert, general manager of the Metropolitan Telephone and Telegraph company, has credit for saving the lives of two little waifs whom he found in a doorway Monday night suffering terribly from the cold. He carried them into his office, and, after warming and feeding them, sent them home in charge of two linemen. A.

From Dakota.

JAMESTOWN, March 16.—Jamestown is now well lighted by electricity. Two 300 light Edison incandescent machines have recently been installed. A Brush arc machine of twenty lights capacity is in operation and the streets are brilliantly lighted. Some trouble was experienced in completing the preliminary work on account of the blizzards which terrified one or two Southern men who were engaged here to install the plant. The company expects soon to undertake power work. The officers of the company are: President, Anton Klaus, sr.; vice president, E. H. Schwelenbach; treasurer, Anton Klaus, jr.; secretary, Charles Rattinger; superintendent and electrician, D. M. Stedman. Jamestown is a growing town and feels proud of the possession of one of the most complete, and satisfactory plants in the country.

A large number of persons from different sections of the state have visited the Jamestown plant and from their remarks it is inferred that before long that station will be duplicated in a large number of towns in Dakota.

Gentlemen interested in electric lighting say that Dakota is one of the best fields for electric light in the country and they predict that it will soon be possessed of a larger number of lights in proportion to the population than any similar district in the union. The Jamestown company has received such cordial support that the plant will probably soon be enlarged.

The insane asylum at this place is now lighted by 250 incandescent lamps. A new 300 light machine is to be put in operation immediately. The wiring has already commenced.

The telephone company has 90 subscribers and is doing an excellent business. The company charges $4 per month for the rental of instruments.

There is talk of forming companies for introducing electric light at Devil Lake and Spirit Wood. D.

Fire at Helena, Mo.

HELENA, MO., March 12.—The Helena electric light plant was destroyed by fire to-day. The loss is heavy; insurance will cover loss on machinery. It will be at least six weeks before the lights can be restored. W.

Kansas Notes.

WICHITA, March 17.—The Schuyler company is putting in a new 30 light arc machine. The company is considering the advisability of increasing its plant. D.

THE ELECTRIC MOTOR.

The *Manufacturers Gazette* has this to say concerning the relative merits of the cable system and electric railroad: "Give the cable and electricity a clear track, and both will be cheaper than locomotive engines, and electricity is much the safest. Cable roads built in the busy parts of Boston will not be allowed a cable speed of over 3½ miles per hour; they cannot run faster and pay bills for worn-out cables and grips. Cable roads may be built, and probably will be. They will relieve cheap horses from high pressure duty and overwork, but for the successful transport of our workers twice every day, cable roads will prove a failure."

In reference to the electric fire engine of which mention was recently made in these columns. *Fire and Water* says: "Of course, it is looking pretty far ahead to imagine a city with a system for distributing electric power as complete as that of the present system of water-works, in every street of which of which an engine could take power with the same readiness with which it now obtains water. Much more wonderful results than this have, however, been accomplished within the memory even of children."

J. Howard McCormick is operating at New Orleans, a new cotton seed cleaner by means of an electric motor. The contrivance works admirably and attracts much favorable comment.

The Chicago north side cable system has been unusually unfortunate. The Chicago papers are predicting its successful operation in A. D. 1900. The *Daily News* has this to say of the latest misfortune which befell the cable: "The north side cable service would have been in operation today but for an unhappy occurrence which befell the system at a late hour last evening. Between 10 and 11 o'clock a yellow dog (the ownership of which has not yet transpired) appeared suddenly at the corner of Elm and North Clark streets and snapped and snarled viciously at the cable engine house over the way. By this unlooked-for incident the machinery was thrown out of gear and the operation of the cable has necessarily been postponed. The Baron Yerkes is keenly disappointed, but in his grief he is somewhat consoled by the assurances of sympathy which come in from every side. We have it on indubitable authority that the cable will begin running some time, provided the moss and lichens can be scraped off the machinery before that date."

THE ELECTRIC LIGHT.

The electric light has been introduced in Abyssinia.

One of the latest attempts to harness the forces of nature for the service of man is the adaptation of a windmill for the turning of a dynamo, the electricity thus obtained being stored in suitable batteries and afterward used in lighting beacons for the benefit of the maritime interests. There is a station of this kind near the mouth of the Seine, and considerable success has been obtained.

A business soon likely to assume considerable prominence is that of furnishing temporary light for special occasions by means of storage batteries. The plan has already met with great success in Chicago and New York city.

At the last meeting of the Chicago common council, and ordinance giving a franchise to the Co-operative Electric Light company, was referred to the law committee.

Prof. Barrett, city electrician, and commissioner Frank Blair are endeavouring to devise a plan to consolidate the electric light plants of the city hall and county building in Chicago. It is thought that money could be saved by such an arrangement. Prof. Barrett estimates that the cost of running the two plants as one would cost $12,000 per year.

THE TELEGRAPH.

The following is taken from the Chicago *Daily News*: "Mayor Roche has assigned a policeman to watch the rooms occupied by a concern known as the Western Telegraph company, of New York, and the Union Telegraph company, of Chicago, which is advertised to teach telegraphy, and give the graduates positions on its own line. The mayor's attention was called to the matter by persons who 'graduated,' and made applications for positions at the Western Union telegraph office, only to be refused. The policeman's duty will be to meet all persons applying at the 'school,' and inform them that the concern is not what is represented in its advertisements, as it has no telegraph lines and can therefore furnish employment in telegraphy to no one." Mayor Hewitt adopted a similar policy in reference to a similar telegraph school in New York City.

Personal Paragraphs.

F. W. Cushing, superintendent of the Chicago Arc Light and Power company, has been granted a much needed vacation and will spend two months in travel through Texas and California and, possibly, Mexico.

William F. Moake, who had charge of the fire alarm telegraph of New Orleans, has resigned the position and his assistant, Mr. Butler, has been promoted to fill the vacancy.

David McCargo, superintendent of the Allegheny Valley railroad will be appointed, it is said, manager of the Pennsylvania company's lines west of Pittsburgh. Mr. McCargo began life as a messenger boy in the service of the Atlantic & Pacific Telegraph company, at Pittsburgh.

Miscellaneous Notes.

It is said that Mr. Edison proposes to present the first half dozen perfected phonographs to the crowned heads of Europe. He will charge each instrument with a suitable presentation address and the recipients will have the pleasure of hearing the inventor's compliments and assurances of esteem in his own words.

A press dispatch from Pittsburgh dated March 17th, says: "Another new move was recorded to-day in the electric light war being waged between Inventor Edison and the Westinghouse company. Judge Acheson in the United States district court to-day filed an opinion in the case of the Consolidated Electric Light company (Westinghouse) against the McKeesport, Pa., Light company (Edison), over ruling the demurrer of the latter company and ordering it to file an answer within thirty days. The suit is brought to test the validity of the claims of the Westinghouse company to the exclusive right to manufacture the incandescent lamp used by both companies. The Edison company filed a demurrer setting forth that the patent was contrary to law by reason of its having been issued to the Electro Dynamo company, while in the meantime the ownership had been vested in the Westinghouse company. If the demurrer had been sustained the effect would have been to declare the patent invalid. Judge Acheson decides that the patent was properly issued, and the order to answer within thirty days will compel the Edison company to fight out again the question of priority of invention."

The *Revue Scientifique* gives the following table of sizes of carbons to be used with currents of varying degrees of intensity:

Intensity of current.	*Diameters of carbons.*
From 2 to 3 amperes	2 millimeters
" 3 to 5 "	4 "
" 4 to 6 "	5 "
" 7 to 10 "	7 "
" 10 to 11 "	9 "
" 11 to 15 "	10 "
" 12 to 16 "	11 "
" 13 to 20 "	12 "
" 15 to 24 "	13 "
" 16 to 25 "	14 "
" 25 to 30 "	15 "
" 30 to 45 "	17 "
" 35 to 60 "	18 "
" 40 to 80 "	20 "
" 50 to 120 "	25 "
" 80 to 180 "	30 "

W. Elmore, an English electrician, has succeeded in obtaining a deposit of fibrous copper by electrolysis, by which a seamless pipe can be produced, having, it is said, a tensile strength 50 to 100 per cent. more than that of the best brazed pipes. Copper of a very low grade can be used for this purpose, so that such pipes can compete with similar pipes made by the ordinary process. This new process consists in breaking up the crystalline structure as it is formed, converting it into an interlaced and matted fibrous structure. This is done by depositing the copper on an iron mandrel, which rotates constantly in the electric bath, and on which an agate furnisher, having a spiral motion, moves slowly lengthways, back and forth, the respective speeds of each being so adjusted that a copper deposit seven-thousandths of an inch in thickness takes place during each longitudinal passage of the burnisher. When a sufficient thickness has been attained, the coated mandrel is subjected to a bath of superheated steam, which expands and detaches the copper so that the mandrel can be drawn out.

Various tests show a capability of resisting a tensile strain of 27 to 41 tons per square inch, producing an extension of 5 to 7½ per cent. per 10 inch length. The metal can be drawn, bent, compressed or hammered without annealing or showing any tendency to crack, and under the microscope its structure appears perfectly compact and homogeneous, while ordinary drawn copper appears honey-combed and crystalline, connected only at points. It is anticipated that this process will furnish copper steam pipes of a strength hitherto unknown, and copper of greatly improved quality for all industrial purposes.

Business Mention.

The Chicago Arc Light & Power company has announced to its patrons that it is prepared to furnish, in addition to its arc light service, a current for running electric motors. In its announcement, the company says: "A special wire, particularly adapted to carrying this current, is being put under ground and every arrangement made to furnish a reliable and absolutely satisfactory service. The electric motor solves the problem of securing power from a fraction of one horse-power to ten or more horse-power at the smallest cost, at the smallest expenditure of room, and with a complete absence of heat, dirt, smoke and other annoyances that are inseparable from a steam, gas or other form of engine. It requires absolutely no attention. There are now a number of motors made by the Baxter Electric Manufacturing & Motor company in service in Chicago, and they are doing magnificent work. The cities of the east are using them by the hundreds, and they have been tried for three or four years and found all that could be wished for. This company assumes full charge of the motors, furnishing a competent man to inspect, clean, oil and adjust them. The rates are placed at a figure below those charged for any other kind of power, and this, with the advantages enumerated above, makes the motor all that can be desired."

The Railway Telegraph Supply company has taken the general western agency for the manufactures of the Electric Gas Lighting company of Boston. A complete stock of gas lighting apparatus will be carried, and orders will be filled at once at manufacturers' prices.

The *Scientific American* of February 25th, contained an interesting article descriptive of the plant of the Okonite company, of New York. The methods of preparing the insulated wires are described in a popular way, and several illustrations increase the interest in the subject matter. Following is an extract: "The tenacity and toughness of okonite, rendering it non-liable to destruction by reason of abrasion or rubbing, and the fact that it is not susceptible to extreme ranges of temperature, have made this insulator highly popular among all users of electrical supplies, and the company have the highest indorsements as to its value from many of the largest users of insulated wire, here and abroad. Okonite wire has been subjected alternately to a temperature of 20° below, and 350° above zero, the tests being repeated a number of times, the result showing no apparent change in the quality."

Electrical Patents.

Issued March 13, 1888.

379,221. Coupling For Joining Electric Wires. Carl Hering, Philadelphia, Pa. The invention pertains to couplings, or splices for joining the ends of wires, particularly for wires which are used as conductors of electricity. Claim 3 is as follows:

"A metallic coupling for connecting wires, consisting of two parallel split tubes having two of their edges integrally connected and their other two edges abutted against each other by an intervening connection adapted to receive wires within the tubes, and, upon the tubes being bent together, to clamp them."

379,255. Incandescent Lamp Socket. Frank Thone, Oskaloosa, Iowa.

379,284. Dynamo Electric Machine. Lewis C. Rice, Denver, Colo. The invention consists in a dynamo electric machine or an electric motor made up of an external and internal ring either of which may be rotated, the coils of the stationary ring being connected to a set of contacts and switches whereby the magnetism of the ring may be shifted at will. We give the claims:

"1. In a dynamo electric machine or motor, the combination of the concentric inner and outer rings having their cores composed of annular disks placed side by side with intervening air spaces and in line radially, whereby the air spaces may be in direct alignment.

"2. In a dynamo electric machine or motor, a field magnet having the location of its two polar points independently adjustable relative to the armature, whereby the machines may be regulated and adjusted."

379,339. Fire Alarm Signal Box. George M. Stevens, Cambridge, Mass.

379,344. Apparatus for Dressing Off the Commutators of Dynamo Electrical Machines. Daniel J. Tittle, jr., Albany, N. Y.

379,368. Telegraphic Pen. Herschel P. Copeland, East Orange, N. J. Primarily a learner's instrument in which the learner is guided to a certain extent by the eye as well as by the sound in sending messages. We give two of the claims:

"1. In an electric circuit, which includes a suitable receiving apparatus, a transmitting pen provided with circuit terminals, one of which is movable and located upon the pen, so as to be moved in the act of writing.

"6. A telegraphic pen having a pair of relatively movable terminals, one of the said terminals being located in position to be operated by the index finger in writing, in combination with a cap, band, or circuit closer adapted to press the movable terminal into contact with the corresponding terminal."

379,372. Non-Polarizing Constant Current Battery. Frank J. Crouch, Eugene City, Ore.

379,396. Electric Gas Lighter and Extinguisher. Geo. L. Hogan, Olmstead, Ky.

379,404. Device for Returning Signals in District telegraph Systems. William V. Lockwood, Waterbury, Conn.

379,406. Automatic Electric Spacing Mechanism for Type-Writers. James F. McLaughlin, Philadelphia, Pa.

379,408. Underground Conduit. M. Richards Muckle, jr., Philadelphia, Pa. A car for carrying cables bodily into conduits and a conduit having ledges to sustain a cable carrying car are shown. We give two of the claims:

"3. A duct or conduit for electric wires, made of a solid block of wood or analogous material, having a channel grooved throughout its entire length, with ledges or shelves for sustaining a cable carrying car, and tongues at its upper side adapted to fit in corresponding grooves in the removable cover.

"6. The within described means for carrying a cable or conductor bodily into a conduit, consisting of a series of cars, each having bearings adapted to rest or ride on side ledges of the conduit, in combination with means, as described, for forcing said cars and cable into the conduit from the rear or outer end of the conduit."

379,453. Working Metals by Electricity. Nicholas de Benardos, St. Petersburg, Russia.

Claim 1 runs: "The improvement in the art of joining metals by means of the directly applied electric current, which consists in forming a pocket between the edges of the pieces of metal to be joined together, placing metallic scraps or pieces therein, and then melting or fusing said scraps by means of the voltaic arc formed by a conductor approached thereto, which constitutes one pole, while the metal itself constitutes the other pole."

379,459. Bell Cord for Cars. William Glasgow and Samuel S Stevens, Chicago, Ill. The object of the invention is to provide a signaling device for trains which may be operated either by hand, in the ordinary way, or electrically, to convey the proper signals to the locomotive cab.

Claims 1 and 12 are given: "1. In a combined mechanical and electric signaling apparatus for trains, a continuous pull bell cable comprising a number of insulated electric wires, and providing within itself and throughout its entire length multiple and continuous conductors, in combination with a mechanically operated signal, an electric battery, an electric bell or bells, and means for closing the circuit from one to the other of said conductors, by which entire apparatus the engineer may be mechanically or electrically signalled

"12 In a train signaling apparatus, the mechanical and electrical alarms and a pull cable extending through the train and connected with said mechanical and electrical alarms, and comprising within itself two or more conductors, combined with suitable circuit closers between said conductors, and an electric battery."

379,465, Apparatus for Electric Bleaching. Eugene Hermite and Charles F. Cooper, Dalston, County of Middlesex, England.

379,466. Regulator of Electric Motors. Daniel Higham, Philadelphia, Pa.

We give the claim. "An electric motor having its field magnet pole piece faces laminated transversely to the direction of rotation of the armature, and having main coils on the cores and distorting coils applied to the pole pieces."

379,467. Regulation of Electric Motors. Daniel Higham, Philadelphia, Pa.

The invention consists in an electric motor having a field magnet with consequent poles and pole piece faces laminated transversely to the direction of rotation of the armature, in combination with main coils and distorting coils on the cores.

379,501. Switch for Electric Light and Motor Circuits. Frederick W. Brann and G. Irving Kinney, San Francisco, Cal.

379,503. Pneumatic Carrier. George D. Burton, New Ipswich, N. H.

379,509. Electric Surface Railway. John A. Enos, Boston, Mass.

379,511. Machine for Regulating Time Pieces. William B. Farrar, Greensborough, N. C.

379,532, Test Circuit and Apparatus for Electrical Cables. Isaiah H. Farnham, Malden.

379,535. Telegraph Wire. William Hewitt, Chambersburg, N. J.

The invention consists broadly in combining steel and copper wires in a cable, the steel wire supporting the entire weight of the conductor, while the copper wire acts as the conductor proper.

We give the claims: "1. As an article of manufacture, a telegraph wire composed of one or more galvanized copper wires laid or wrapped with or united to one or more steel wires.

"2 As an article of manufacture, a telegraph wire composed of one or more galvanized copper wires laid or wrapped with or united to one or more galvanized steel wires."

379,551. Primary Electric Battery. Henry Woodward, Detroit, Mich.

379,552. Primary Electric Battery. Henry Woodward, Detroit, Mich.

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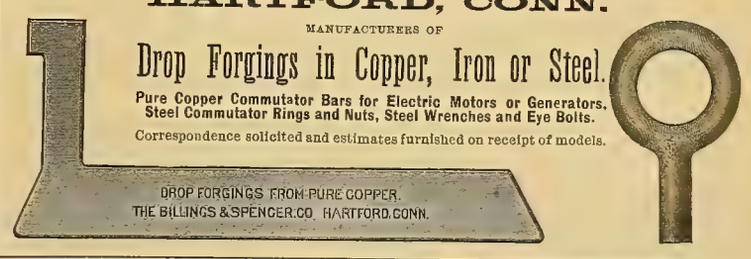

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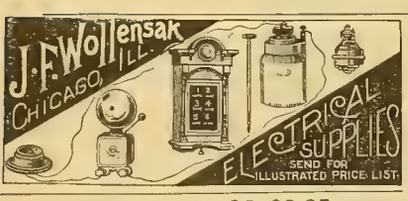

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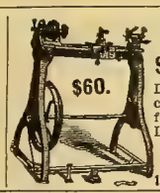

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Designed especially for electricians and others requiring a lathe for accurate work. Catalogue of Lathes, Drill Presses, Tools, etc. mailed on application.

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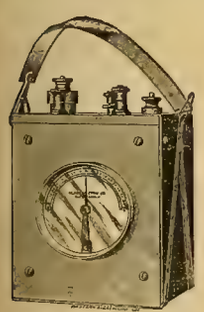

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These sets require no technical knowledge to connect; they are all contained in black, highly finished hard rubber cases, mounted in nickel plate and ready for use. The bell domes are all 3½ inches, the coils are wound with silk covered wire and the contacts are of platinized silver.

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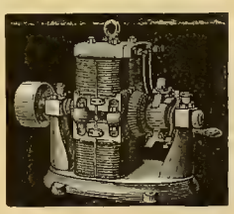

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ARC AND INCANDESCENT ELECTRIC LIGHTING.

The only perfect Automatic Instantaneous Current Regulation.

A 2,000 c. p. Arc Light produced with less than two-thirds of a Horse Power, or twelve 16 c. p. incandescent lamps to one Horse Power.

We are producing 210 2,000 c. p. Arc Lights, Commercial lighting, on 3,400 lbs. of coal per night, from dusk to 1 o'clock, or 2 lbs. of coal per light per hour.

We guarantee that the above lights will successfully compete with any Arc Lights in the world, for ***Size, Whiteness*** and ***Steadiness.***

Advantages, 25 per cent. less in steam plant, and a constant saving in power.

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AGENTS for Lord's Boiler Compound. A chance for engineers and men on the road. Also local agents with means. State present occupation. Address

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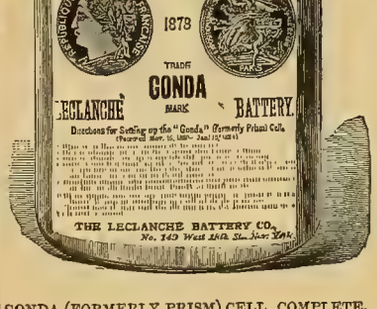

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Are those which bear this **LABEL** and the Trade-Mark, **GONDA.**

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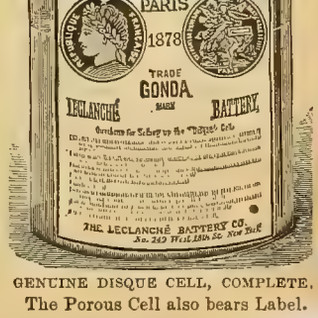

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The Porous Cell also bears Label.

Electric Light Repairing, General Machine Job-Work, Pattern Making, Etc., Etc.

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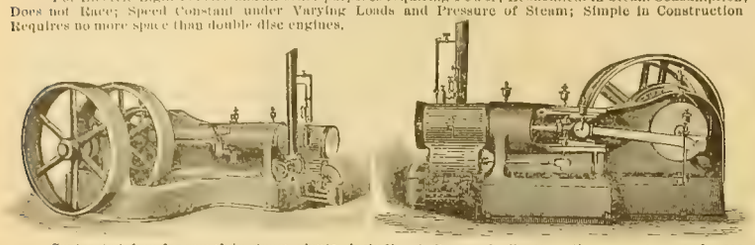
THE BECK AUTOMATIC ENGINE.

For Electric Light Service and all other purposes requiring Power; Economical in Steam Consumption; Does not Race; Speed Constant under Varying Loads and Pressure of Steam; Simple in Construction Requires no more space than double disc engines.



Contracts taken for complete steam plants, including boilers and all connections, masonry and erection. All work guaranteed. Send for Catalogue and full particulars. Address

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Chicago Electric Club.

There will be a meeting of the **Chicago Electric Club** Monday evening, April 2nd, at 8 o'clock, at the rooms of the Club, 122–124 Clark Street.

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PATENT GRAVITY DROP.

ANNUNCIATOR SUPPLIES.

Mansfield Electric Co.,

383 FEDERAL STREET, BOSTON, MASS.

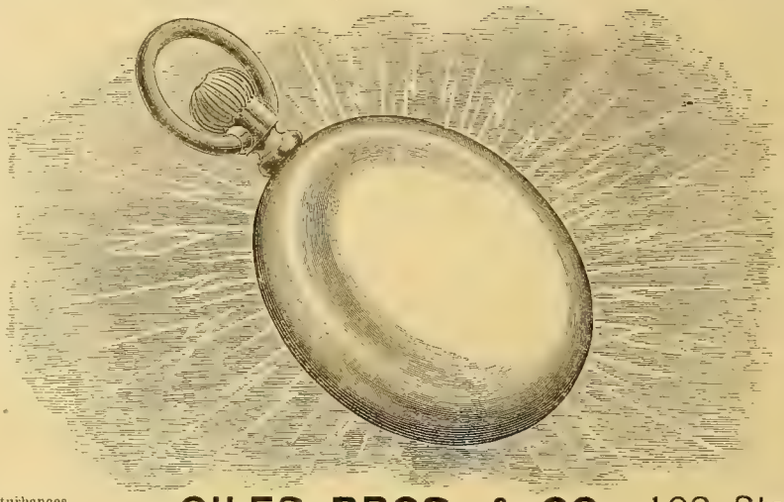
GILES ANTI-MAGNETIC SHIELD FOR WATCHES.

Office of Van Depoele Electric M'fg. Co.
Chicago, Feb. 16, 1886.

Anti-Magnetic Shield & Watch Case Co.

Gentlemen : — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good timekeeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.



"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
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The application of Anti-Magnetic Shields to pocket time-pieces promises to be of very great importance to horologists and watchmakers; it will render operative and fine adjustments and mechanisms which hitherto have been made almost *nil* and in operative on account of their susceptibility to the all-pervading magnetic influence.

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Sure protection from all Electrical and Magnetic disturbances. Send for descriptive circular.

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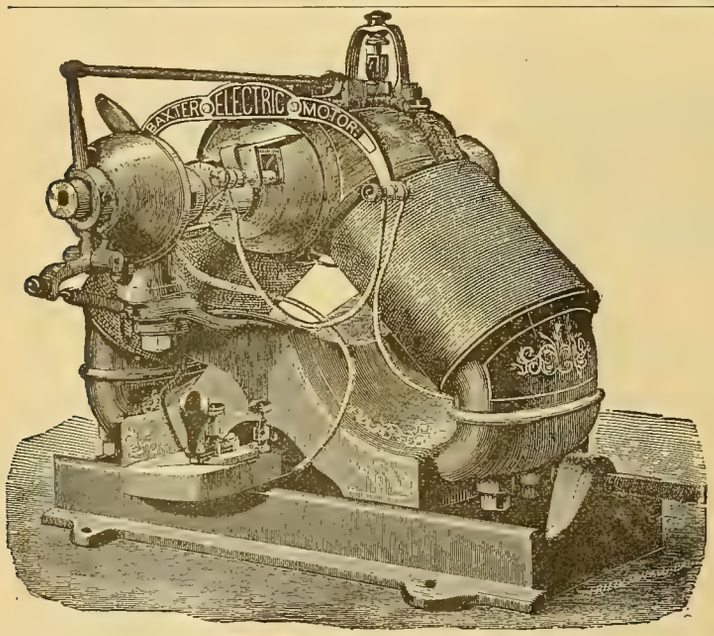

The Baxter Electric Motor.

This Motor is now ready to be placed upon the Market. Manufactured for both

Arc and Incandescent Circuits,

THE ONLY PERFECTLY GOVERNED MOTOR EVER MADE.

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AUTOMATIC

Cut-Off High Speed

ENGINE.

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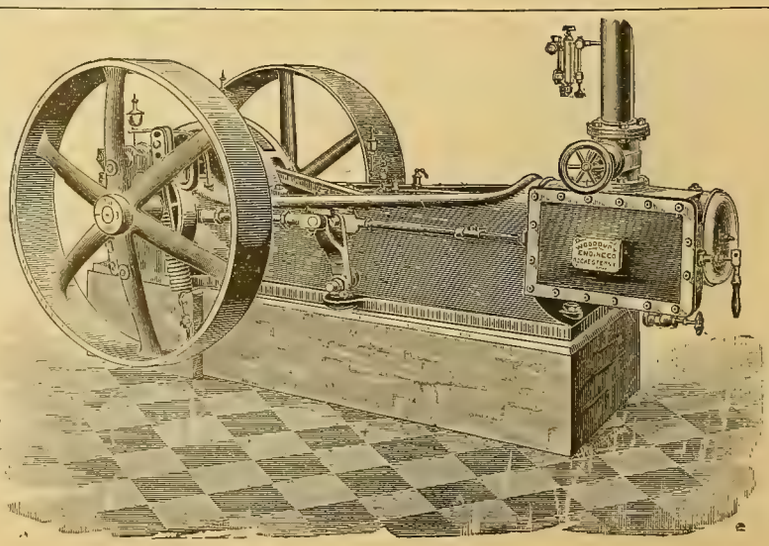

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Plain Slide Valve

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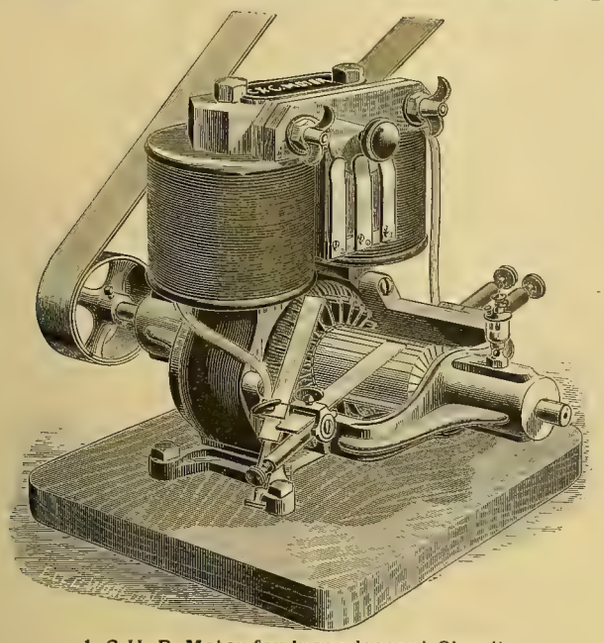

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Repair Work done and Special Manufacturing attended to. Skilled Workmen in all Departments.

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Weather-Proof Line Wire,

FOR ELECTRIC LIGHT PURPOSES.

The Insulation Resistance is good, and is not affected by moisture, heat, cold, acids or alkalies. But little more expense than Underwriters.

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Factories: ANSONIA, CONN.

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Sole Agents United States for APPLEGATE'S ELECTRIC FLOOR MATTING.

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PROMOTERS OF ELECTRICAL INVENTIONS.

Patents bought outright, or inventions handled on royalty, We have superior advantages for placing patented articles on the market. Correspondence with inventors solicited.

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EXPERIMENTAL WORK UNDERTAKEN, MODELS MADE, Etc., Etc.

THE LAW TELEPHONE COMPANY

Begs leave to announce that it has largely increased the quantity and surface and greatly improved the form of the negative element of the

LAW BATTERY.

The New Form

IS CLEARLY SHOWN IN THE CUTS AND NEEDS NO EXPLANATION.

ITS ADVANTAGES.

The Battery holds up longer when overworked, recovers quicker when relieved, and the material being all in one piece instead of in two pieces, the breakage heretofore suffered in transportation, in handling, and in any depolarizing treatment (after accidental short circuiting) will be wholly saved. "*It was good before; it is better now.*"

The Battery *otherwise* is unchanged. The negative element is of the same material and undergoes the same preparation as before, and is *everlasting*, and so guaranteed.

THE OTHER FEATURES OF SUPERIORITY, NAMELY:

Connections that will not corrode,
Lock-tops that absolutely prevent evaporation and creeping of salts,
Absence of grease, Flint glass well annealed,
Hard rubber bolt connection that is reliable and durable,
Pure zinc and pure sal ammoniac, etc.

ARE ALL PRESERVED.

What *folly* it is to use a negative element of the perishable kind! *And no one knows this better than the maker of it!* But his chief profit is in the *sale of* "*renewals*," hence he not only makes it but sells his complete Battery at a low price in order to "*build up a business in renewals.*" And he succeeds and laughs in his sleeve! There is a "Lamb" in the case with whom "ignorance is bliss."

The circular issued a month ago by the Leclanche Battery Co. in respect to a Decree having issued against the Law Telegraph Co.—which went out of business four years ago—for infringement of "what *has been* known as the Law Battery," we have not deemed worthy a reply, because—first, the infringement was only in an insignificant detail in construction, which was absolutely valueless in the old form of the Battery, and is not found in the new; and, second, the circular seemed to elicit commendations of our Battery and increased orders for it, and nothing more.

Now, however, apparently encouraged by our silence, the Leclanche Co. is publishing their circular in the Electrical Journals, clearly with the view of making capital of the case and securing some of our trade by being persistent. This is going too far, and therefore we "rise to explain."

The Court did not decide that any of the claims of the patent had been infringed except the fourth and fifth claims, which read as follows:

"4. The improved electro-negative element shown, which consists of *two* conglomerate bodies united with and surrounding a *central* conducting-plate, substantially as described.

"5. In an electric battery, the combination of a cover adapted to close the cell containing the exciting-liquid with a zinc pole and an electro-negative pole, which consists of a *central* carbon plate and *two* electro-negative conglomerates attached thereto, both of said positive and negative poles being supported by the cover, substantially as shown and described."

A mere glance at these claims shows that they relate only to a Battery in which "two" conglomerate bodies are united with a "central" conducting or carbon plate, all the other features being old and well known. To infringe these claims there must be "two" such bodies and the plate must be "central." Nothing more is claimed. In fact, it is admitted in the case, by their electrical and patent expert, that "one" conglomerate body united with a conducting or a carbon plate, would be no infringement of these claims.

Moreover, we find that an electro-negative element having *one* conglomerate body united with a conducting carbon plate, is also old, having been shown and described in a patent many years before the Leclanche-patent in question.

But, this fact, and that of their admission, are really superfluous; the explicit limitations in the claims are quite sufficient.

Now it is self-evident that in the old Law Battery there has been no advantage, profit or benefit to maker, seller or user, in having the negative element in *two* bodies rather than in *one*, it being entirely feasible to put not only enough but more than enough quantity and surface in *one* body to give the very best attainable results. In truth, it has been disadvantageous and less profitable, for *two* are more fragile and more expensive to make than *one*. "It is an ill wind," etc.

There is no probability of a suit for so worthless an "improvement" (?) being brought against any of our customers, but if a suit is brought, we will of course protect and defend it and pay all damages, if any, awarded thereunder. We are informed they have repeatedly offered to settle *all* damages for $250—and, finally, just before the trial, they offered to settle for nothing, provided they be permitted to take a Decree; their counsel then remarking that the damages they could recover, if any, would be slight, or words to that effect. These facts indicate the amount of our liability for the past! For the present and future, as stated, we cease to infringe.

The suit was thought to be unwarranted and unjust from the outset, and therefore as a matter of principle has been defended and will now be carried to the Supreme Court, where it is confidently believed by able counsel that the decision will be reversed.

LAW TELEPHONE CO.,

NEW YORK, March 17, 1888. 112 Liberty Street.

SLATTERY INDUCTION SYSTEM

MANUFACTURED AND CONTROLLED BY THE

Fort Wayne Jenney Electric Light Company,

FORT WAYNE, INDIANA.

The most carefully worked out and complete Alternating System of Electric Lighting in Existence.

ARMATURE

Guaranteed

Converter

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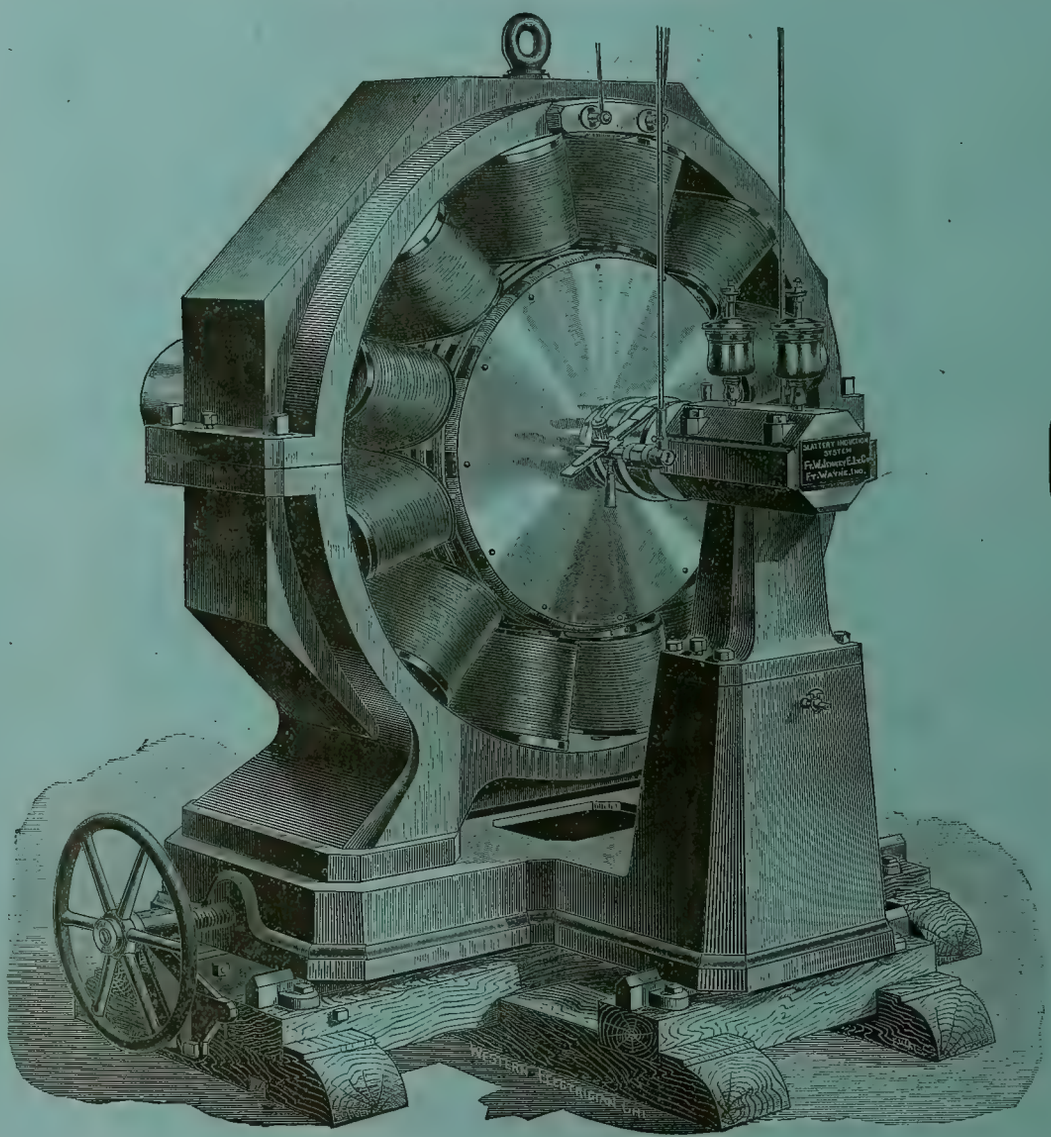

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16

Candle Power Lamps

TO THE

Horse Power Guaranteed.

SLATTERY ALTERNATING DYNAMO.

Fort Wayne Jenney Electric Light Company,

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AND

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CITY OF MEXICO OFFICE MEXICO, F. Adam, Successor.

Western Electrician.

EVERY SATURDAY.

Vol. II. CHICAGO, MARCH 31, 1888. No. 13.

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General Offices, No. 708 PENN. AVE., PITTSBURGH, PA.

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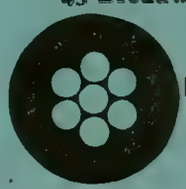
45 Broadway, New York. 154 LaSalle St., Chicago,

—MANUFACTURERS OF—



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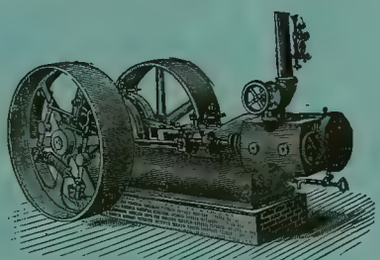
Builders of High Grade Self-Contained



Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

ELECTRIC LIGHTS

And other duty requiring close regulation of speed.

WESTERN OFFICE AND WAREROOMS:

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LEATHER LINK BELT TESTIMONIAL.

THE SPRAGUE ELECTRIC RAILWAY AND MOTOR CO.,
Office, 16 and 18 Broad Street,
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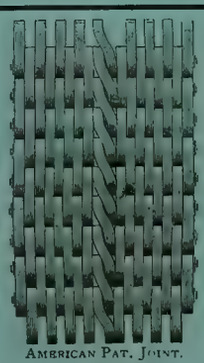
Messrs. CHAS. A. SCHIEREN & Co., 78 Cliff St., N. Y.

GENTLEMEN:—We have pleasure in testifying to the value and reliability of your Link Belts. At the American Institute Fair, recently held in this city, we ran our two large dynamos by their means, and during the three months they were in use, they were satisfactory and gave us no trouble whatever. We especially recommend them for the ease and quickness with which they can be made endless.

Yours very truly,
SPRAGUE ELECTRIC RAILWAY & MOTOR CO.
H. McL. HARDING, General Agent.



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ANSONIA BRASS & COPPER COMPANY,

Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

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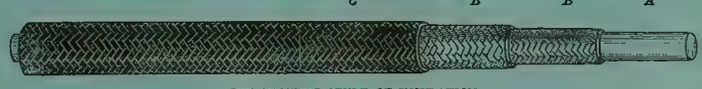

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A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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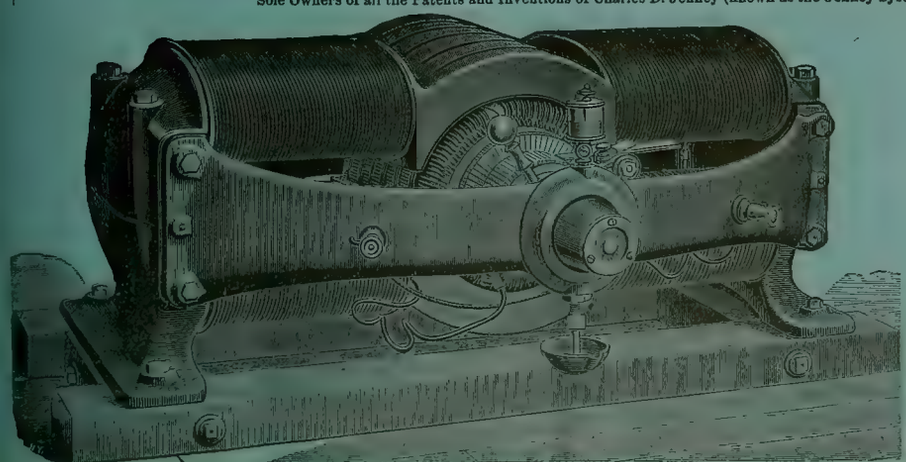
INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mines, Shops, Factories, etc., with Individual Plants.

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Electric Arc-Lighting

IN THE WORLD.

SERIES LAMPS

—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883.
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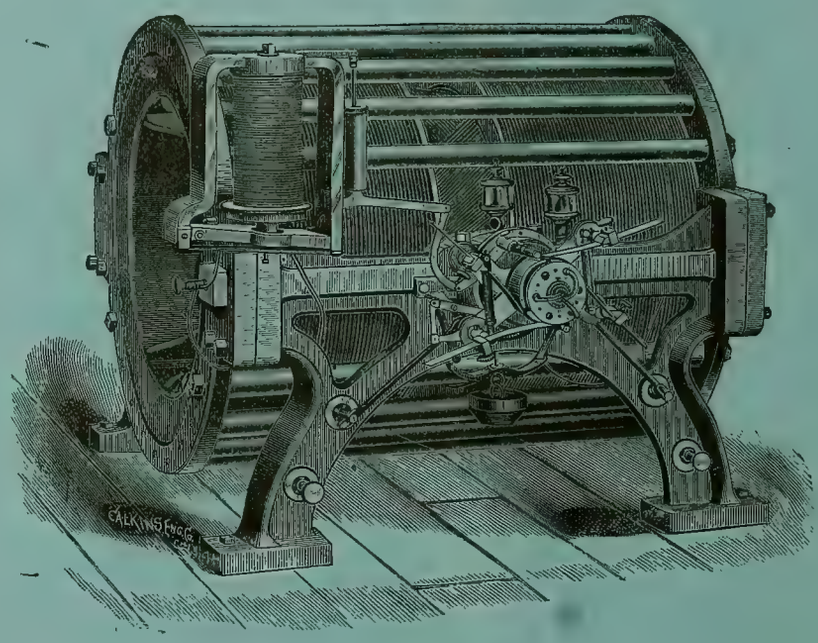
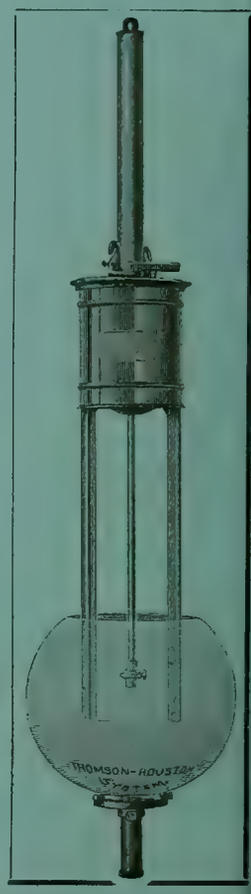


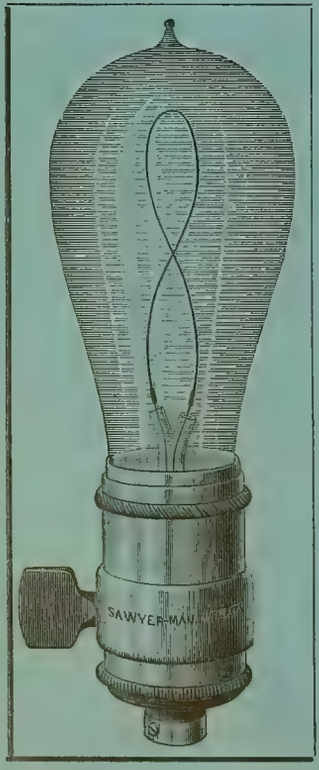


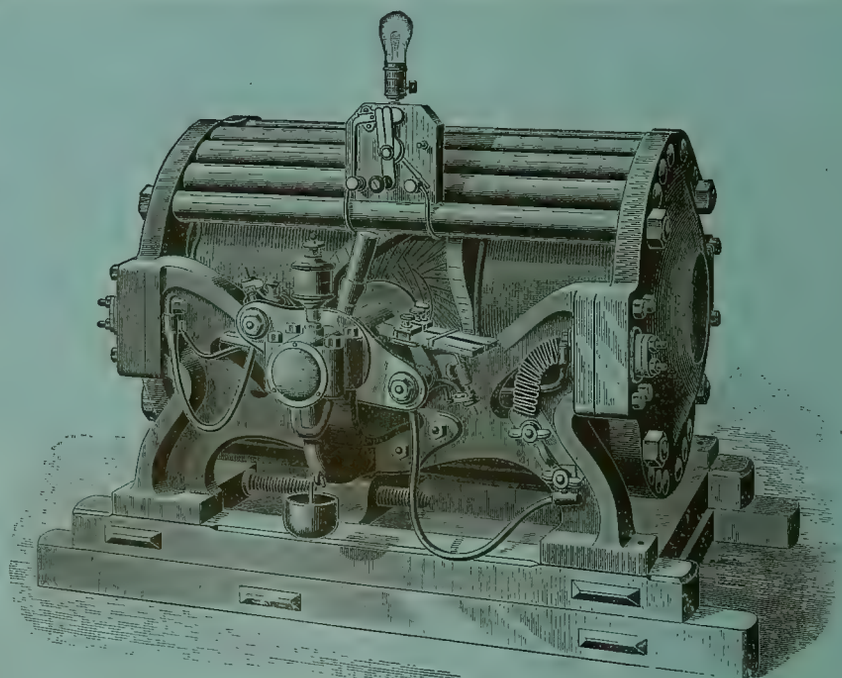
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

Chicago & Northwestern R. R.

Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.
G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

LEONARD & IZARD, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(SIGNED) G. H. THAYER, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

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U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals 11 $\frac{50}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals 6 $\frac{44}{100}$ per H. P.

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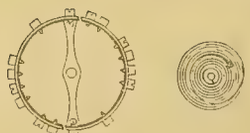

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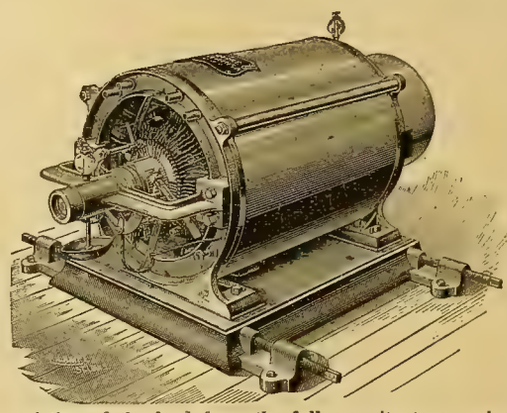

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Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

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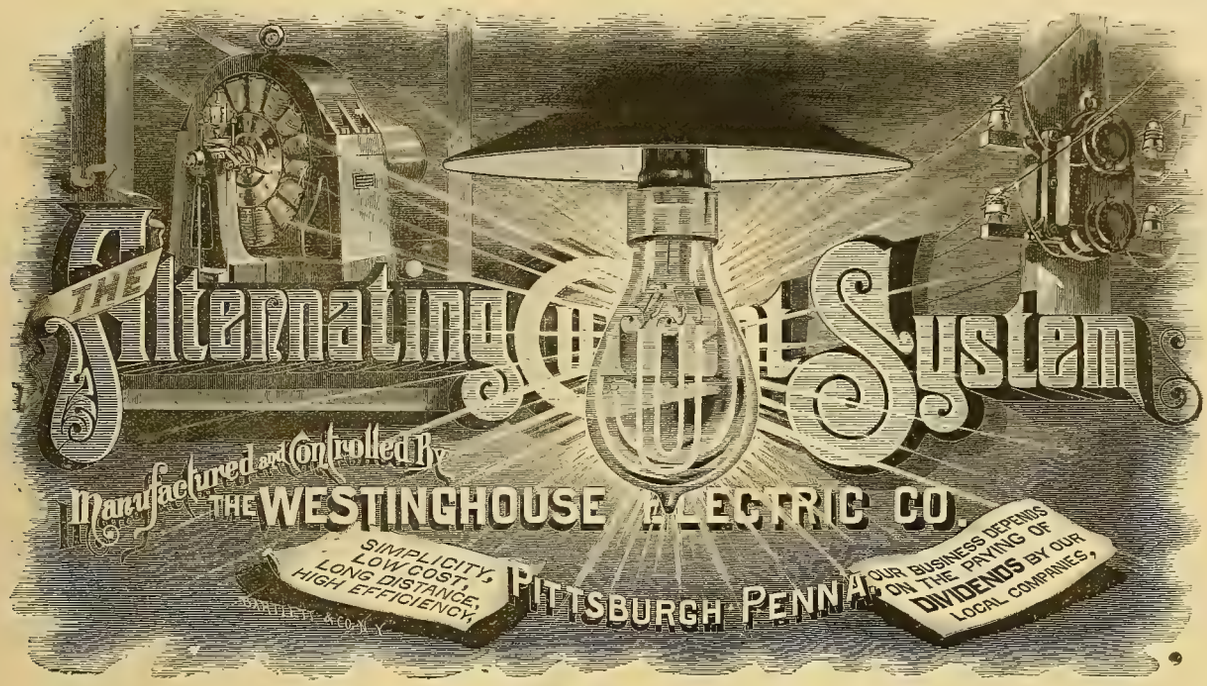

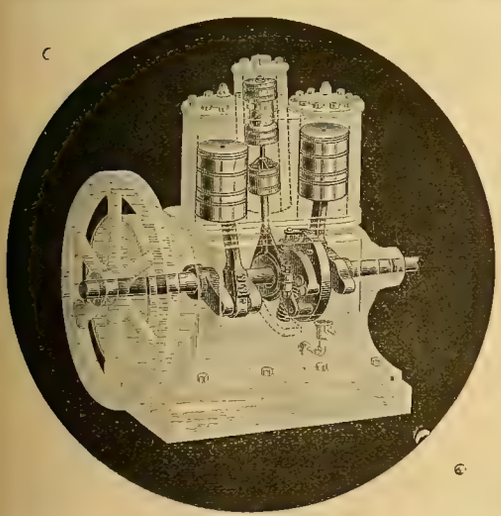

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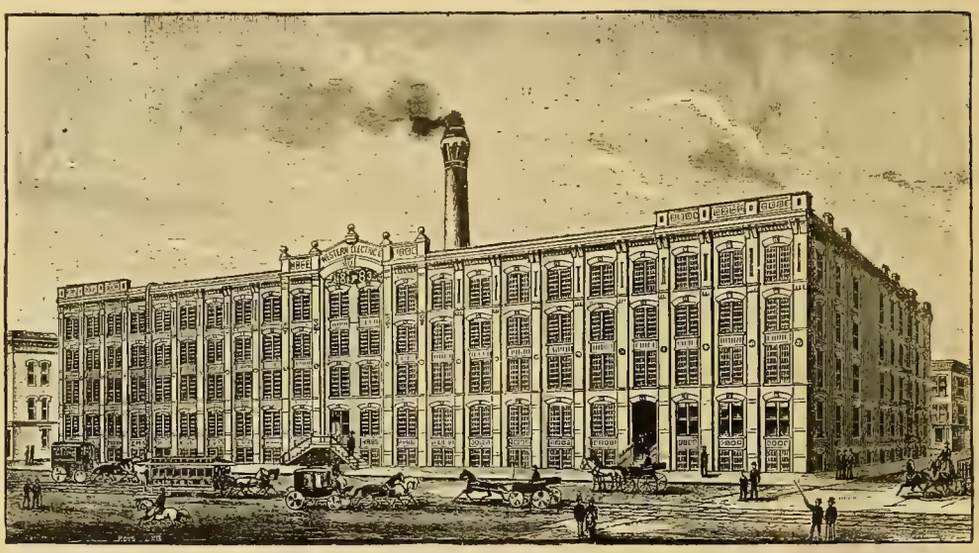

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Size No. 13, B. and S. Gauge, 6-32 inch Insulation, which has been in use, but is practically as good as new. We will send a sample of this Wire and quote a very low price to anyone who inquires. The price is so low that it is cheaper to use this wire than new wire of even No. 16 gauge, so this offer is of advantage to anyone who wants Kerite Wire of sizes Nos. 13, 14, 15 and 16.

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Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, MARCH 31, 1888. No. 13.

Hotel Annunciator.

The accompanying cut shows a hotel annunciator and guest call made by the Railway Telegraph Supply company of Chicago for the Kansas City Electrical works. It combines in its construction all the requisites of a first-class annunciator. It is reliable; its mechanism is as perfect as skilled workmanship can make it. It is simple in its construction and handsomely finished. The company is manufacturing these annunciators in large quantities.

Wires and the Sleet Storm.

It was feared that the sleet storm of Sunday would cause considerable damage to the telegraph and electric light wires in Chicago. While damage was done in the southern part of the state the city fortunately escaped, thanks to a rise in the temperature. There were a few crosses, but beyond that no trouble was reported. Springfield, Ill., suffered badly and telegraph communication was temporarily interrupted. Along the Wabash road considerable damage was done. A hundred telephone wires were down at Decatur. The storm caused considerable trouble with telegraph and telephone wires in Iowa.

Watt's Electrolytic Zinc Process.

Alexander Watt has for some time been perfecting an electrolytic process of his own invention for obtaining pure zinc from the ordinary impure metal, and also for the extraction of zinc from its ores. He has been aided in the latter process by W. C. Mountain's experience in the construction of dynamos specially adapted for copper refining, by which he has been enabled to obtain the most suitable current for the electrolytic deposition of zinc from solutions containing its ores. The metal is deposited in a perfectly reguline form, free from the crystaline growth known as treeing, and without the evolution of hydrogen at the cathodes, from which polarization and its waste of energy arises. Zinc of great purity is said to be obtained by this method from the crude oxide, and at a cost much below that of the ordinary smelting process; no appreciable loss occurring by the new process, while the old it is said involves a loss of 15 to 20 per cent. Ores of low grade can be reduced by this process, which could not be reduced economically by smelting. The entire process, both of purification of zinc and its extraction from the ores, is to be put in practical operation on an extensive scale.

Electric Light Competition.

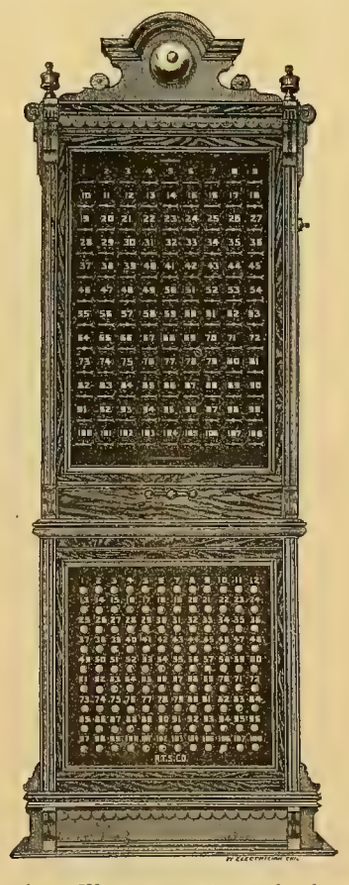
"All's fair in electrical competition just as it is in love and war" said a gentleman who represents a large company. "When I was in a small southern town, I met an agent of a competing company who told me he was going to get a franchise to put in electric lights at G—. I told him I had been thinking of the same thing. He left the next morning for G— by steamer, I walked to the landing with him and wished him luck. When I got back I began to think over my own chances at G—, so I telegraphed to a neighboring city to have a machine of our make sent overland to the nearest railroad station and from there forwarded to G—. I calculated that as my friend went by steamer he would not get to his destination very soon. I hurried off to the place by rail. When I reached there I got a franchise without any difficulty. My machine came all right. I made arrangements to secure power and on the third night I had fourteen lights burning. The next day I put up six more arc lights. All of them were in operation when my friend reached the town. I met him at the landing. It was night and when he saw those twenty arc lights his eyes were as big as dollars."

"How did he feel about it?" asked a listener.

"Oh, that was all right. He would have done it himself. We were the very best of friends."

Telephone Companies and the Bell Patents.

The officials of the Inter-State Telephone company of Chicago, say that they are not in the least disturbed by the decision which affirmed the validity of the Bell patents. One of the officers of the company is quoted as saying: "It can not affect us in any shape. We are operating under the Hopkins patent, which is for the broken current system. I don't know much about patent law, but some of the best patent lawyers in this city say our patent can not be broken by Bell or



anyone else. We propose to push ahead and build lines in the city."

D. C. Boley, general manager of the Cushman Telephone and Service company, when asked what effect the decision of the supreme court had on the company, said:

"We consider it favorable to our case, which is now pending in the United States court before Judge Blodgett. The evidence is all in, and the case will be argued as soon as it can be reached. Our case is based on different grounds from points argued at Washington. We claim that Dr. S. D. Cushman discovered the process and art of sending articulate sounds by means of electricity in 1851, and put it in use. What Cushman discovered in 1851 includes all there is in the Bell patents of 1876-'77—the receiver. The transmitter, which has made the telephone valuable as a means of communication was not patented until two years after the Bell patent. Now if we prove this to be a fact the court will hold that Cushman by his laches dedicated his discovery to the public, and hence that part of the recent decision relating to Drawbaugh's failure to perfect his invention can not apply to the Cushman case."

Raworth's Battery and Detector.

Raworth's combined battery and detector consists of a battery and galvanometer contained in a walnut case 4 x 3½ inches, by 5 inches in height. The galvanometer and dial are in one piece, which can be removed from the case, the connections being made by sliding the dial into place. The agglomerate Leclanché cells are used, two for light work and four for telegraph work, and are sealed in ebonite cases, and permanently coupled inside the case. By means of a mirror inside the hinged lid, which opens in front of the dial, the movements of the needle can be seen when the instrument is placed on the floor or hung round the operator's neck. A German silver resistance coil is fixed in the case, and the arrangement of the terminals is such that the battery, galvanometer and resistance can be used separately or in combination. When properly calibrated the instrument answers the purpose of a resistance meter, and a reference to the standard resistance which it contains shows any deterioration in the cells, for which allowance can be made in the reading. The terminals are labeled outside, and a diagram showing connections attached to the lid inside, also a tabular scale for calibration notes.

D'Unger Long Distance Telephone.

The D'Unger Long Distance Telephone company, of Chicago, has been incorporated with a capital of $10,000,000. The incorporators are Dr. J. E. Keefe, Dr. W. L. Copeland, and Dr. T. A. Broadbent, of Chicago. The inventor, Dr. D'Unger was found at his office in the Palmer house by a representative of the WESTERN ELECTRICIAN. He said, in response to a question:

"Yes, we propose to begin active work at once. If we are enjoined by the Bell company, we will give bonds and prepare to sustain our position. We think we can do that without any trouble. Here is the instrument."

The doctor has telephones resembling in external appearance the ordinary instruments attached to wardrobes, which are placed at opposite ends of the room. "If you will step to that telephone," continued the doctor, "I will make a resistance of about 800 miles and see if you can hear me." The experiment was successful. The doctor's message was reproduced.

"I will now give you a second illustration of the practical operation of my telephone. By means of the resistance box I will interpose a resistance of 196,000 ohms, equal in round numbers to 10,000 miles. Try the instrument again."

This time the sounds of the doctor's voice were somewhat blurred at first, but, subsequently, when he changed his position slightly the message was plainly heard.

"Now as to actual practice," said the doctor; "we have talked to Milwaukee, and the sound was as clear and distinct as my voice is now. Just as far as the current will extend over the wire just so far can my telephone be operated."

Dr. D'Unger explained the construction of the telephone by saying that he applied the principle of the lever, to magnify the sound of the voice. The lever connects at the center the diaphragm and extends to several swinging carbon points, which are each about an inch in length.

"You can see," said Dr. D'Unger, continuing the explanation, "How such an arrangement works in practice. Whether the person, who sends the message speaks loudly or softly, it makes no difference. The Bell telephone is ruined in this way. Jones, with a loud voice, comes up to the Bell instrument, and roars like a bull. Perhaps, you hear him ; but, when Brown, with his meek voice, wishes to talk, no one can hear him. I claim that my instrument is a scientific one ; the Bell is not based on scientific principles. If it were, each instrument would not differ in action from every other one. I have tried a great many Bell instruments and I find that I can not be understood when I talk through some of them."

The Electrolytic Pole Indicator.

This instrument described in the London *Electrical Review*, is an ingenious application of electrolysis to effect what hitherto has been done by means of a galvanometer, the advantage being that it can be used with certainty in the neighborhood of the strongest magnetic fields It consists of a small glass cylinder closed at both ends by metal caps bearing screw terminals. To these caps are fastened on the inside two platinum wires. The cylinder is filled with a clear liquid which, on the passage of a current, becomes decomposed, and shows a strongly defined purple tinge at the negative pole. On the cessation of the current the decomposed matter is redissolved in the liquid, which again becomes perfectly clear. The instrument can be used an in-

definite number of times without any prominent discoloration of the liquid. The indications are perfectly apparent with as low an e. m. f. as 4 volts, and it is small enough to be conveniently carried in the pocket, and is strongly made to prevent breakage.

Electro-Magnetic Traction Increasing Apparatus.

The subject of increasing tractive adhesion of vehicles and motors of various kinds on the system of Elias E. Ries, of Baltimore, Md., reference to which was made in No. 9, Vol. 1, of the WESTERN ELECTRICIAN, is again brought up by patents granted him and Albert H. Henderson, March 20th, and briefly referred to in the proper department this week. One patent has reference to a traction increasing system for electric railways, another to apparatus for increasing the traction of vehicles and motors, and still another to electro-magnetic traction increasing apparatus. The latter is made the subject of the illustrations in connection.

The invention referred to has for its object the increasing of the traction or friction between the wheels of railway cars and the track rails by means of magnetism, whereby a greater coefficient of traction or friction is produced between the points of contact between the wheels and rails, for the reason that a radical change in the relative position of the molecules of metal composing the respective structures, due to the establishment of a closed magnetic circuit therethrough, obviously increases the tenacity or bearing of the wheels upon the rails, and as the wheel has the same polarity at all points of its periphery, this tenacity is obtained without discommoding or decreasing the ease of revolution and without adding to the weight of locomotion or occasioning the use of objectionable traction expedients, such as sand.

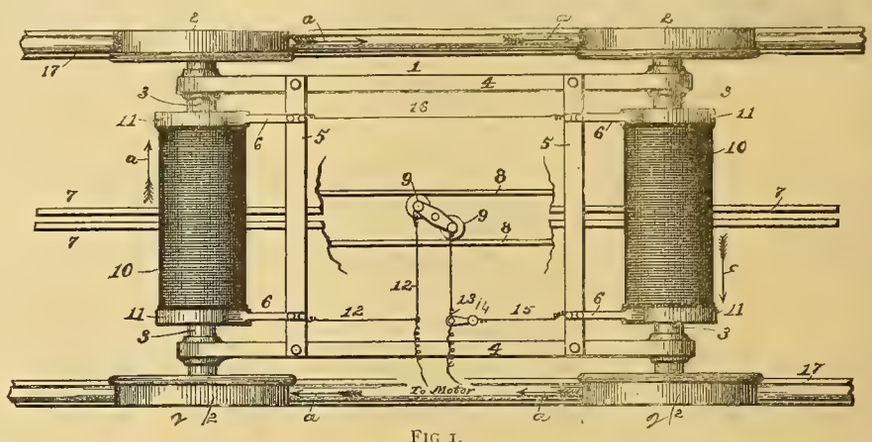


FIG 1.

Fig. 1 is a diagrammatical view, showing a skeleton truck of a street car, the helix of wire wound upon each axle, and electrically connected by brushes with a branch circuit from the current collecting wheels, which derive their current from the line, which in turn is arranged below in a conduit, the two helices being in series, as shown, and connected in such a manner as to induce magnetic lines of force to flow in a continuous direction around the magnetic circuit formed by the axles, drive wheels, and track rails.

Fig. 2 is a similar view showing the manner of arranging the helices upon a street car truck where an electric motor is used as the propelling power, there being in this instance four helices instead of two, arranged similarly in series, the energizing current being obtained from a source separate to that of the motor.

For carrying out the invention, a helix of wire permanently wound concentrically around a suitable core is employed, the core being magnetically in circuit or contact with the wheels—say, for example, the axle, which carries a pair of wheels, one on each side. A current of electricity derived from some convenient and constantly available source is passed through the helix, instantaneously energizing the axle and converting its respective extremities (the wheels) into magnetic poles of opposite polarity, and consequently imparting magnetism to the rails upon which said wheels are bearing, the magnetic circuit being completed through the rails intervening between the front and rear car wheels on each side, thus forming a complete magnetic circuit.

In Fig. 1, which shows the arrangement as applied to an underground conduit railway, *1* indicates the car truck, consisting of the flange wheels *2 2*, the axles *3 3*, and the brace rods *4 4*, supporting the cross bars *5 5*, which carry each a pair of metal contact brushes, *6 6*; *7 7* are the slot rails of the conduit, shown broken away underneath the truck 1 for the purpose of exposing to view the ordinary current conducting rails, *8 8*, and *9* designates the current collecting wheels or traveling contacts, which make contact with the rails *8 8* as the car proceeds along the line of way ; *10 10* are the helices, wound, respectively, around the axles *3 3*, and having their terminals (not shown) electrically connected, respectively, with the metallic disks *11 11*, which are each insulated from the body of its respective helix *10* and from the axle *3*.

From the circuit which extends from the collectors *9* to the motor a branch or shunt *12 13* is taken, one wire *12*, leading to the brush *6* on the lower rear side and the other wire *13*, passing to the lever switch *14*, the contact point of which is electrically connected by wire *15* with the corresponding brush *6* on the lower front side of the car ; *16* is the wire connecting the two remaining brushes *6 6* with each other. Thus, as the car proceeds, should it be desired to increase the tractive effects between the wheels *2 2* and the rails *17 17*, the motor man adjusts the lever switch *14* upon its contact point, thereby closing the circuit through the helices *10 10*, magnetizing the axles, and converting the wheels *2 2* into enlarged pole pieces of opposite polarity. Commencing at the switch *14*, the current flows over its circuit through the helices in the direction of the arrows. When these helices are thus energized, they induce magnetic lines of force in the iron axles and wheels in the direction of the arrows *a a*, these lines being conducted along the iron rails intervening between the rear and the front axles, forming thereby a complete and unbroken magnetic circuit. It will be fairly apparent that these magnetic lines of force must pass serially and successively through all the wheels *2 2* before the magnetic circuit is complete. Therefore, a powerful attraction or adhesion of the different molecular structures will be produced at the points of contact between the rails and wheels, at which point the degree of magnetic saturation is greater, owing to the relative difference in the mass of magnetic metal and the position of the molecules of iron in the said rails and wheels, which are thus of uniform direction throughout the circuit.

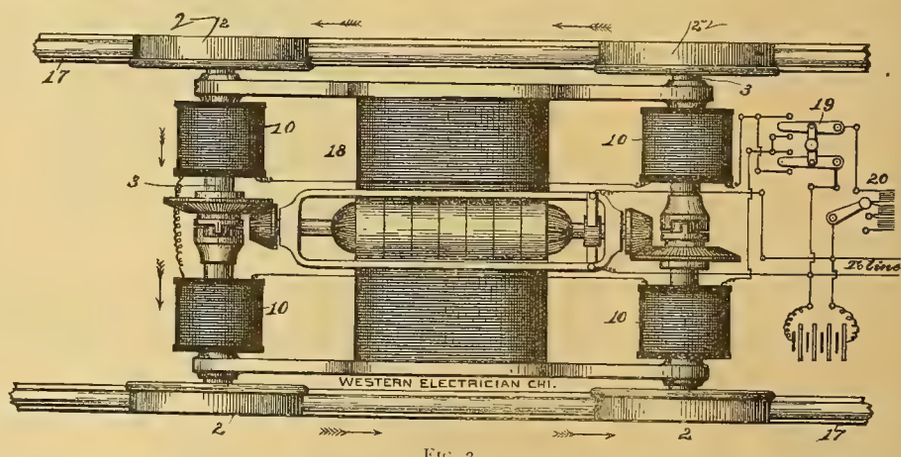


FIG. 2.

Referring to Fig. 2, the arrangement is substantially the same, except that, owing to the construction and gearing of the motor *18*, there must be four helices instead of two—a pair for each axle—the neutral line of magnetism being preferably midway between the two helices on each axle. In order to prevent diffusion of the

lines of force from the magnetic circuit in Fig. 2, the motor and its supporting frame are magnetically insulated from the axles. As in Fig. 1, these helices are connected in series, as shown, but are in this instance energized from a separate source from that of the motive current, which source is conventionally shown as a battery, either of the primary or storage type. Again, another difference between these arrangements is that there is shown a regulating switch, *19*, whereby it can be shifted so as to change the direction of the current through the several helices; furthermore, an adjustable resistance, *20*, is intermediately in the circuit from the battery for the obvious purpose of graduating the resistance of the circuit.

The helices *10 10* in Fig. 2 may be either mounted loosely on their axles or may revolve therewith, as in Fig. 1, and may be connected in series or in any other convenient or effective manner, whereby the lines of force will pass serially and successively through all the wheels, rails, and axles, as is well known and obvious to those skilled in this art.

Hawkeye Electric Company.

The Hawkeye Electric Manufacturing company, of Oskaloosa, Iowa, is a young, but growing, and energetic corporation The company was organized but a little over two years ago. Finding its quarters too small for its constantly increasing business, the company was forced to erect suitable buildings of its own. The buildings were completed, and the company moved into them November 10, 1887. The main building of the company is a two story and basement brick, 50 by 126 feet. In this building are contained the offices of the company, the electrician's laboratory, the pattern rooms, machine shop and winding room. In the basement are situated the boilers and engines of 20 horse power. The steam plant is mainly used for testing purposes, the entire machinery of this building, employing about sixty hands, being driven by a Thone automatic motor, manufactured by the company, and furnished with motive force by the Edison electric light plant. There are several machine shops, two newspaper offices and other manufacturing establishments using these motors for their power. The foundry, brass and iron casting department is 60 by 120 feet situated parallel to the main building. The entire establishment is on the line of the Burlington and Western and Chicago, St. Paul and Kansas City railroads, which gives excellent shipping facilities. This company manufactures arc lighting machinery; incandescent lighting machinery; electric motors for both arc and incandescent circuits, or for any kind of current; voltmeters; ammeters and electrical instruments. The officers are: W. F. Durfee, president; C. P. Searle, secretary and treasurer; and E. H. Gibbs, vice president. They are all well known business men and capitalists of the city. William Bowen, the general manager, is a well known and popular business man, and has charge of the city water works, in addition to his responsible position with this company. Frank Thone, the electrician of the company, is well known among electrical men and is a gentleman of high scientific attainments. The company have recently secured the services of Mr. Schaefer, formerly of Fort Wayne, who will assist Mr. Thone, and have charge of the incandescent lamp department. The company will erect soon a large addition to the works. The company now have offices as follows: W. M. Talcott, 85 Madison street, Chicago, Ill.; Edgarton Bynner, 94 Liberty street, New York; and Charles Grover, 552 Main street, Kansas City, Mo. The company's office and works are at Oskaloosa, Iowa. The accompanying cuts illustrate several of the specialties manufactured by the company.

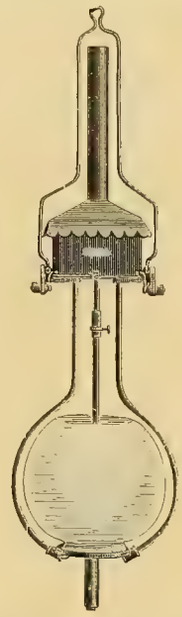


FIG. 2.

DYNAMO.—The bed of the Thone dynamo, Fig. 1, is a strong cast iron plate, shaped somewhat like a Greek cross. This plate forms the base of the machine. On the extreme ends of this plate are bolted the pole pieces, shaped like "}", so bolted to the bed plate that they stand opposite to each other in a horizontal position. The ends of the pole pieces opposite each other are flared so that each one forms the section of a circle, between which revolves the armature. By this peculiar construction of the field magnets, in connection with the bed plate, and the singular shape of the ends of the pole pieces in thus partially surrounding the armature, the resistance of the lines of force is reduced. The armature is of the well-known Pacinotti or Gramme type with several modifications. The core is built up in sections instead of in one continuous mass. By this means the eddy current is reduced, and better ventilation of the core and copper sections is secured. The shaft rests at each end on ball joints. The arrangement of the commutator is such that it can easily be removed and a new one put in place in less than thirty minutes.

ARC LAMPS.—The arc lamp, Fig. 2, manufactured by the company has the merits of brilliancy and steadiness. Several improvements make them especially advantageous in practical use. Particular attention is paid to the magnets, cut outs and insulation. Double and single lamps are made.

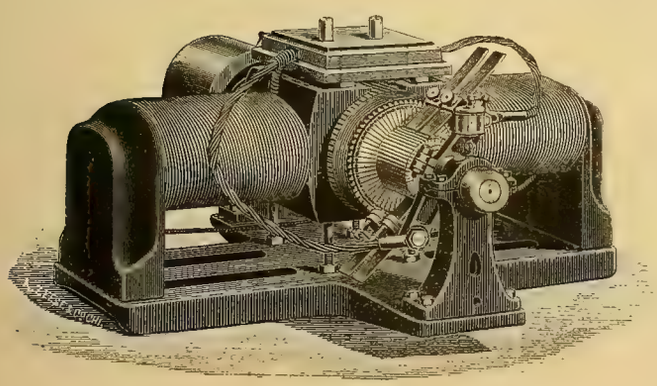


FIG. 1.

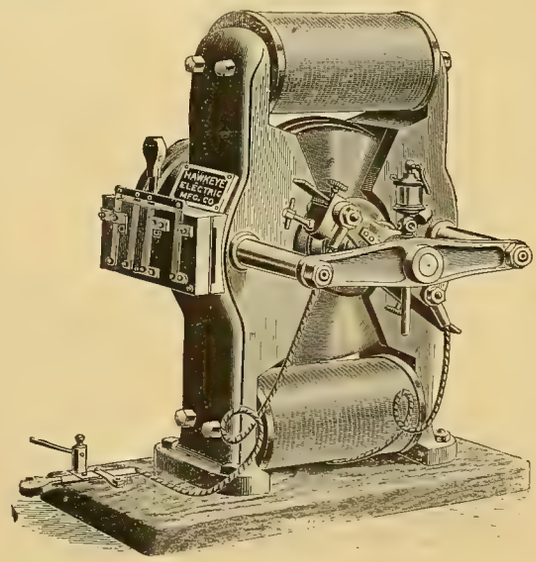


FIG. 4.

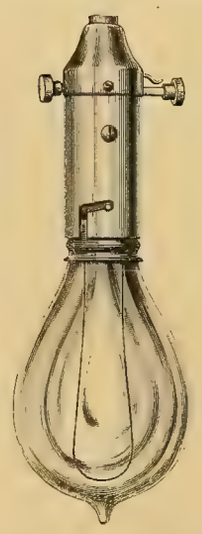


FIG. 3.

INCANDESCENT LAMP AND LAMP SOCKET.—The claims for the lamp, Fig. 3, are long life, constant candle power without tendency to blacken. The merit of the socket, the company claims, consists in the use of a slide to make or break the circuit, instead of a key socket. The advantage in using the slide is that it is positive in its action, and one hand is sufficient to switch the lamp on or off. The socket and lamp are fastened together by a bayonet slot.

MOTOR.—The company claims for the Thone motor, Fig. 4, great regularity, simplicity, absence of parts requires frequent adjustment, small space, compact and rigid form. In the construction centrifugal governors and methods of governing speed by shifting brushes or by means of resistance boxes have been discarded. The principle employed in the construction of the motor gives a constant speed, the company claims, under all conditions of load.

The contract for lighting the plant of the Chicago City Railway Co., at the corner of State and 20th streets has been awarded to the Excelsior Electric company through the Western agent F. W. Horne. The contract calls for 77 arc lights and 155 incandescent lamps. The latter lights will be used in the offices and the barn. The award was made after a thorough trial of several systems. The wiring was begun on the 26th inst. The agency of the Excelsior company is now located at 11 Adams street.

Dynamo Tenders' Hand-Book.[1]

By F. B. Badt.

PART III.

LAMPS.

(Continued.)

Chapter XXVIII.

Multiple Arc System.

Fig. 20 shows the method of connecting lamps for the dynamo in multiple arc. Each lamp is independent, and any number of lamps can be switched in or out without

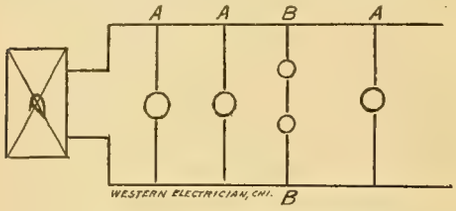


Fig. 20.—Lamps in Multiple Arc.

interfering with the other lamps, provided the e.m.f. between the parallel mains is kept constant. Generally lamps of the same e.m.f. are connected in the same system, but if, for instance, we should want to use 50 volt and 100 volt lamps in the same system, we would connect the 100 volt lamps direct between the mains, as shown in the drawing, with *A*, and the 50 volt lamps is series of two, with *B*. The two lamps marked *B*, of course, are not independent; if one should break or be switched out, the other lamps would go out also.

Chapter XXIX.

Multiple Series System.

In some cases it is necessary to use dynamos of a higher e.m.f. for incandescent lighting, and in such cases the lamps are connected between the two mains in series, Fig. 21. If, for instance, the electromotive force of the

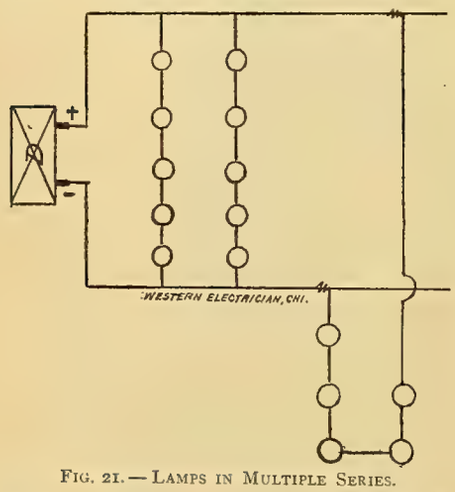


Fig. 21.—Lamps in Multiple Series.

dynamo is 500 volts, and 100 volt lamps should be used, five lamps would have to be connected in series in order to divide the e.m.f. properly. In this system, of course, if one lamp in one series should break, the other lamps of

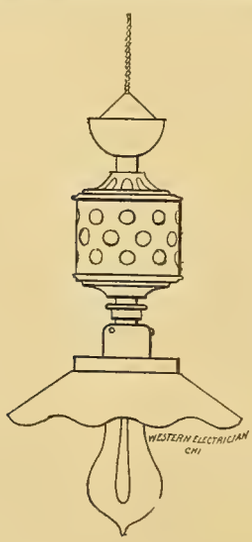


Fig. 22.—Lamp in Multiple Series.

this series would go out also. This has been practically avoided by providing each lamp, Fig. 22, with a little cut-out and connecting in the circuit an extra lamp or a resstance coil. If one lamp should break or be switched out, the cut-out will switch into its place an equal resistance. This arrangement will prevent any other lamp in the series from going out, and sustain the same current strength

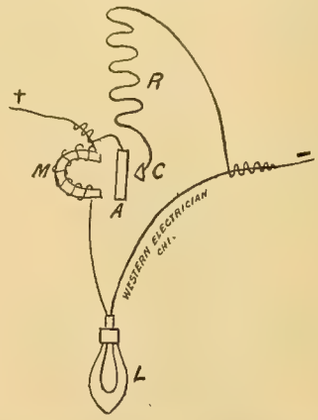


Fig. 23.—Cut-Out for Lamp in Multiple Series.

through the whole series at all times. The device is explained by Fig. 23, in which *M* is the magnet, *A* armature, *R* resistance equal to lamp, *C* contact, and *L* lamp.

The current generated by the dynamo in the multiple series system will be in proportion to the number of series burning. The more series switched in the more current will be required. In this system, as well as in the multiple arc system, a constant e.m f. is required in the main wires, while the current strength will vary in proportion to the number of lamps or number of series.

In the multiple series system, of course the switching out of one or more lamps ina group will not result in any saving in the power of the engine or waterwheel; a saving is effected only by switching out one whole series or more at a time. This is a disadvantage in comparison with the multiple arc system, in which the switching out of one lamp means a proportional reduction in the power needed to run the dynamo.

A little saving in power is of no consequence where fuel is cheap or a water wheel is used.

In larger stores, or places of amusement, where all the lights are required at one time the multiple series system in regard to saving of power stands on an equal footing with the multiple arc system.

Chapter XXX.

Series Multiple System.

In this system the current strength of the dynamo must be constant, and the number of lamps for each group will depend upon the current strength generated by the dynamo and the current strength required for each lamp, Fig. 24. For instance, the current of the dynamo is 10 amperes, and each lamp requires 2 amperes; 5 lamps would be connected in each group, to divide the current properly and give each lamp its share. Of course, instead of 2

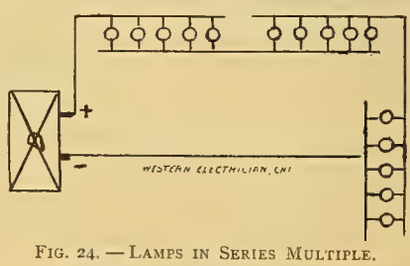


Fig. 24.—Lamps in Series Multiple.

lamps of 2 amperes, 1 lamp of 4 amperes, or 4 lamps of 1 ampere, could be used.

All the lamps, however, in one group must be of the same e. m. f. In this system the e. m. f. of the dynamo must be varied in proportion to the number of series burning in a similar way as in an arc light circuit. In fact, in in this sense each group of lamps can be considered as an arc lamp, and this is the reason that persons engaged in the electric light business very often speak of incandescent lamps running on arc light wires, simply meaning that the lamps are connected in series multiple, as explained.

Chapter XXXI.

Arc and Incandescent Lamps on the Same Circuit.

It can be easily seen that in place of a group of incandescent lamps in the series multiple system, as described, an arc lamp may be inserted, Fig. 25. Such a combination, however, is neither advisable nor practical as the fluctuations of the arc lamps will show in the incandescent lamps.

In this system, as well as in the series multiple system, a similar disadvantage to that described in Chapter XXIX, will occur if one of the lamps should break. The lamps, of course, will not go out, but if one lamp should break, the remainder of the lamps in the same group will brighten up considerably and thus injure the life of the lamps. If not discovered in time, more lamps may break and finally the whole series may go out and break the circuit entirely. The breakage of the last lamp in the series might cause considerable damage to property, as owing to the high e. m. f. of the dynamo, a considerable arc may be set up which may destroy the lamp fixtures and set fire to the building. The disadvantage can be overcome by the same cut-outs as described in chapter XXIX, so that if one lamp should break or be switched out, an equal resistance will be shunted in and an even distribution of the current among the lamps will be kept up. In some systems one

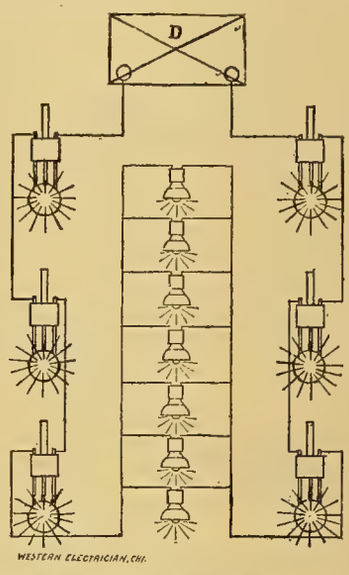


Fig. 25.—Arc and Incandescent Lamps on the Same Circuit.

single distributing box is used in place of the single resistances and cut-outs The principle, however, is the same. If one or more lamps break or are switched out, a resistance is put between the wires of the series automatically, thus causing the same result, namely, keeping up a constant strength of current for each individual lamp.

Chapter XXXII.

The Alternating System.

In this system, Fig. 26, alternating currents of high e.

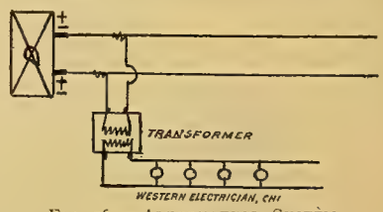


Fig. 26.—Alternating System.

m. f. are employed. These currents traverse the primary wires of induction coils while the lamps are placed in circuit with the wires of the secondary coil. Owing to the high e. m. f. employed in the main conductors the latter may be made very small and lamps can be run at long distance requiring a comparatively small investment for copper wire.

The induction coils called converters or transformers are connected in multiple arc with the mains. The incandescent lamps are also connected in multiple arc with the wires starting from the secondary coil. Each lamp in this system is independent of the others and may be switched in or out at will.

Arc lamps may be run in this system at the same time with incandescent lamps.

INSTRUMENTS.

Chapter XXXIII.

Current Indicator or Ampere Meter.

This apparatus is to indicate the current strength at all times. It should be put up in each case where a constant current strength is required as in arc light circuits or in the series multiple system of incandescent lighting. The instrument must be connected in series with the arc lamps or with the groups of incandescent lamps in the series multiple system. It is also used in the multiple arc or multiple

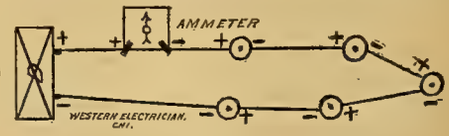


Fig. 27.—Position of Ammeter.

series system and is always put in one outgoing wire of the dynamo, Fig. 27.

[1] Dynamo Tenders' Hand-Book, by F B. Badt; 100 pages, 70 illustrations; flexible cloth binding; type page 6 x 3 inches; published by Western Electrician Co., price $1; now ready for delivery.

Chapter XXXIV.

Pressure or Potential Indicator, or Voltmeter.

This instrument is absolutely necessary on dynamos which must be kept at a constant e. m. f., as in the multiple

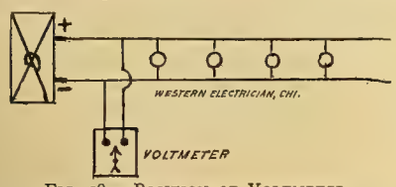


Fig. 28.—Position of Voltmeter.

arc or multiple series system of incandescent lighting. The instrument is connected in parallel with the lamps, as shown in Fig. 28.

Chapter XXXV.

Current Regulator.

This instrument, also called rheostat or resistance box, consists of a box which contains wire or some other resistance and which can be switched in or out of the electric circuit by means of a crank. If this is to be done by hand, the instrument is called a hand regulator; if done automatically it is called an automatic regulator.

The regulator for series dynamos is connected anywhere in the circuit, the whole current generated by the dynamo passing through it. By putting more or less resistance in the circuit, the current flowing through the other parts of the circuit can be strengthened or weakened. In shunt dynamos the regulator is put in the shunt winding of the

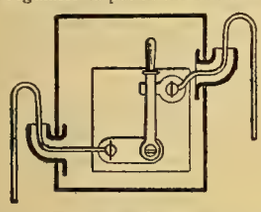


Fig. 29.—Switch.

field. Putting in or taking out the resistance decreases or increases the strength of the field magnets and thus controls the current generated in the armature. In some arc light dynamos the regulation of the current is effected by putting more or less resistance in shunt with the field circuit, and in others by automatic devices for shifting the brushes. The movement of the latter towards the neutral point will decrease the current, while moving it toward the maximum point will increase the current strength. [See Chapter XVIII, Fig. 13.]

Chapter XXXVI.

Switches.

A switch is an instrument to break or make circuit, or, in other words, to cut off the current in certain places for a number of lamps or cut them in again. The switches should be constructed so that they will open and close very quickly and not show very much sparking. [See Fig. 29.] This is accomplished by having the switch so arranged

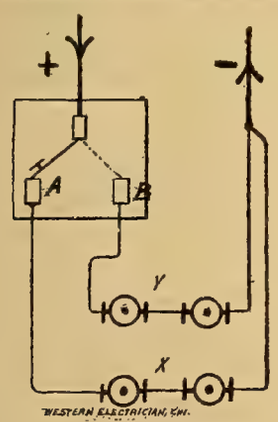


Fig. 30.—Two-way Switch.

that the human hand will start it, while a powerful spring throws the switch open or closes it immediately. The contact should be sufficient to prevent any heating at these points.

Two-way switches are used in various ways; for instance, for two different sets of lamps. If one set of lamps is not required, the handle, as shown in Fig. 30, is moved from *A* to *B* and the lamps marked *X* will go out, while those marked *Y* will be started.

Chapter XXXVII.

Safety Devices.

Strips of an alloy which fuses at a low temperature are used as safety devices, or plugs, in incandescent wiring. The cross-section of the plug must be of such size that it will melt before the wire it protects gets dangerously warm. Hence, the diameter of the safety plug depends upon the cross-section of the wire to be protected and not upon the number of the lamps. The safety plug is not supposed to protect incandescent lamps from an excess of current, but to protect the building from fire by preventing any part of the electric light conductors from getting too hot. The marking of safety plugs with the number of lamps they can carry has misled many an employe of an electric light company to think that the plugs are put in for the protection of a certain number of lamps. The marking of the plugs simply expresses their carrying capacity in 16 candle power lamps instead of in amperes. See Fig 31, in which safety plugs are marked *S*.

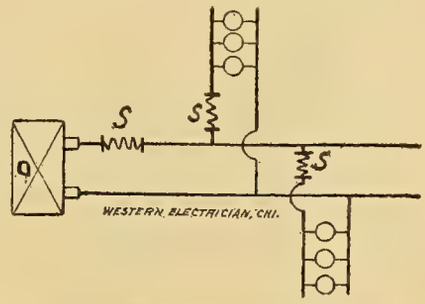


Fig. 31.—Position of Safety Plugs.

The blowing out of safety plugs is very often caused, not by an excess of current, but by poor contact between safety plug and safety plug holder. A poor contact, of course, will generate heat, which will gradually fuse the metal on one end.

Chapter XXXVIII.

Lightning Arresters.

Where electric light lines are put up outside of buildings they are liable to be struck by lightning. To meet such a contingency, the dynamo and station apparatus are protected by a lightning arrester. Fig. 32 shows the simplest form of a lightning arrester; *D* represents the dynamo; *A* and *B* are brass plates, through which the two outgoing wires pass, and *C* is a brass plate connecting to moist earth. The space between the toothed sides of *A* and *B* and the center plate *C* is adjusted to the thickness of a piece of card board. If lightning should come in on one of the wires, it would leap over this narrow space and run into the ground without doing any serious mischief. Such an arrester will keep the lines discharged, and very often during a thunder storm the atmospheric electricity will continuously leap across these plates in the form of blue sparks. These discharges may sometimes cause the center plate to fuse to one or even both toothed plates. In the latter case, the current of the dynamo may follow the arcs which are simultaneously set up between *A*, *C* and *B*, *C*. If the center plate should be fused to both toothed plates the dynamo would be short-circuited through *A*, *C*, *B*, and the belt would be thrown off or the armature, and possibly some of the instruments in the circuit, might be burned.

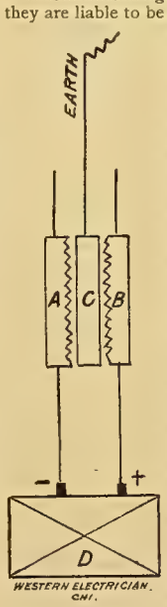


Fig. 32.—Lightning Arrester.

In order to prevent such an accident, numerous devices have been designed to operate in connection with the lightning arrester. They may be classified as follows:

First, Safety fuses inserted between the dynamo and the strips *A* and *B*. They will fuse when the dynamo is short-cuited, break the current and thus save the armature.

Secondly, Electro-magnets which are energized when the dynamo is short-circuited and open the circuit.

Thirdly, Devices which will extinguish any electric arc that might be formed between *C* and *A* or *C* and *B*. Such devices are based on the principle that a magnet will attract the electric arc and pull it away from the plates *A* and *C* or *B* and *C*.

Whatever devices are used, one important point should not be overlooked. This is the absolute necessity of a good earth contact. The wire leading from *C* to earth should be at least a number 4 Brown & Sharpe copper wire. This wire should be solidly connected and soldered to a galvanized iron plate at least ⅛ inch thick and having an area of at least ten square feet on each side. If a pipe is used instead of a plate, the internal area is not to be considered, but twenty square feet of external area is necessary. This earth plate should be sunk so deeply in the earth that even during a dry season it will always be in moist ground. A well or a stream of water is preferable. The earth wire should also be connected to water pipes or gas pipes if they are near by. Such a connection, however, is not a substitute for the earth plate, which is a necessity under any circumstances.

The conductor of the lightning rod of a building must not be connected with the earth wire of a lightning arrester.

All connections underground must be soldered and then painted with asphaltum to prevent corrosion and poor contacts. Poor connections with the earth are very often the cause of the unsatisfactory working of lightning arresters.

It should be borne in mind that no lightning arrester is an absolute safeguard against the freaks of lightning. Very long circuits, especially those not protected by tall buildings or trees, are very liable to be struck by lightning. In such cases extra devices at some points along the line must be put up as an additional protection.

The jaws of the lightning arrester should be kept clean and at a proper distance. It is advisable to run a cardboard between the plates every day to make sure that the jaws are at a proper distance from each other.

Chapter XXXIX.

Ground Detector.

It is absolutely necessary to test electric light circuits frequently, and this means at least once a day, for grounds. In incandescent light installations which run continuously, arrangements to indicate a ground while the dynamo is running should be made. A simple form of ground detector is shown in Fig. 33. Two lamps are connected in series

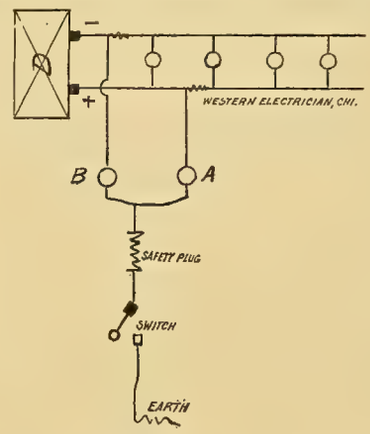


Fig. 33.—Ground Detector.

between the mains near the dynamo. A wire leading to earth is connected between the two lamps; a safety plug and a switch are put into the earth wire. If there is no ground on the line the two lamps will burn very dimly but at equal candle power. If a ground should occur anywhere in the circuit, say on the positive pole, the earth wire and the ground will form a shunt of low resistance to the lamp nearest the positive wire; the result will be that lamp *A* will dim down and lamp *B* will brighten up. Sometimes it may occur that both poles of a circuit are grounded and that the grounds are of about equal resistance. In such a case the two lamps will burn equally dimly. By switching out one lamp, however, it can be seen whether the lines are grounded or not. If the other lamp also goes out the lines are not grounded, but if the other lamp continues to burn the lines are grounded on both poles. To make this test one lamp should be provided with a socket with key.

Instead of two lamps a galvanometer with two coils connected in the same manner as the two lamps may be used. The needle will stand at zero when there is no ground on the line and deflect as soon as the wire gets grounded. Any grade of sensitiveness may be given such an instrument.

Chapter XL.

Switch-Board.

A switch-board is used in larger plants to connect any dynamo with any circuit. Of course only dynamos of the same kind can be made interchangeable. For arc lamp plants, plug switch-boards are generally employed. Short cables with a plug on each end can be inserted in the differ-

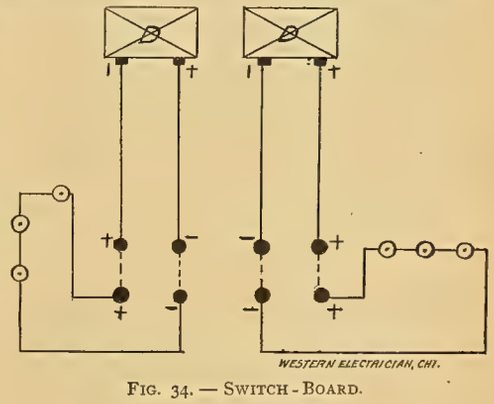


Fig. 34.—Switch-Board.

ent sockets. The latter are marked with + or −, and with *D* (dynamo), *C* (circuit). In addition, they are marked with a number. For instance, *D* 1 (meaning dynamo number 1) can be connected to *C* 2 (circuit number 2), and so on. Fig 34 is a diagram showing the arrangement of a switch-board.

In incandescent plants large lever switches are generally used, as large enough plugs could not be conveniently made to carry the heavy currents of incandescent circuits.

Western Electrician.

EVERY SATURDAY.

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THE Electrotechnical society of Berlin has nominated a committee, composed of the foremost electricians of Germany, including Werner Siemens, Helmholtz, Elsasser, Von Miller, Froelich and Golz, to consider the question of underground conductors.

PROBABLY the last decision written by the late Chief Justice Waite was that which sustained the Bell Telephone patents. Whatever may be thought of the merits of the findings no one questions that the decision was a clear, concise and able opinion.

THE finding of the United States supreme court in the Bell Telephone suits was a "minority" decision. Three of the judges dissented, and two did not consider the cases. Under such circumstances, it is said to be the usual course to grant a rehearing. If the court determines to reconsider the case, the opponents of Bell will, in all probability, try the case before seven judges as in the previous suit. Judge Lamar would be on the bench, but Judge Gray would not consider the case, as several members of his family are interested in Bell Telephone stock.

AMERICAN manufacturers of electric lighting apparatus should feel complimented in the invitation they have received through the advertising columns of the WESTERN ELECTRICIAN to offer bids for lighting the far off city of Wellington, New Zealand, and in another invitation from the same country to bid for lighting another city, Christchurch, given for the first time in this issue. The esteem in which American manufacturers are held in British colonies is again evinced by these invitations.

It is a matter of some pride also to the WESTERN ELECTRICIAN that it should be selected as the medium through which these invitations are extended, showing as it does an appreciation of the extent of the WESTERN ELECTRICIAN'S circulation among manufacturers, users, employes and others interested in the progress of the development of electric lighting.

THERE is a man down in Mobile, Ala., whose sense of the artistic in electric light fixtures found expression in the adornment of an arc lamp in his market by a string of link sausages. The links hung in graceful festoons and without question delighted the aesthetic tastes of those who called at the place. One night the lamp did not burn properly and a young man of sordid qualities forgetful of the art which had directed so charming a display of choice sausages in so prominent a place and with a view of adjusting the lamp, rudely seized the links of sausages to give the lamp a shake. His temerity was quickly checked and his base sense of the artistic was aroused, for the links proved conductors of high quality and he received a shock that laid him on his back.

This incident reinforces the comment upon Mr. Swan's excellent paper on the artistic in electric lighting. Electricians will see that their laurels are in peril; if they can not devise lamps that will satify the longings for the artistic in the hearts of users of lamps, the users themselves will devise arrangements or ornaments that will crown themselves with glory.

THE article on artistic electric lighting, by H. Swan, to be found in another column, is admirably written in an easy, popular style, by a practical electrician of eminent ability, and presents a phase of the subject which has not received the attention which it merits. Electricians have been so absorbed in the practical questions of economy, and efficiency, and in the numerous details of dynamo construction, lamps, distribution, transformers, commutators and other matters pertaining to the various systems of electric lighting, that the artistic, aesthetic phase has been overlooked, to a certain extent. In the department of domestic electric lighting, especially Mr. Swan makes an eminently practical point when he says that the ladies must decide the question, and that any installation, however practical and economical, which offends good taste will not, and should not, be tolerated when results equally practical and economical can be obtained by an artistic arrangement.

Fortunately the incandescent lamp is superior in this respect to any light ever invented. It can be placed in any desired position with perfect safety; lights of any required illuminating capacity can be grouped together, placed singly, hung from the ceiling, or attached to wall brackets at any angle, or arranged in any form to produce the most artistic as well as the most efficient effects; and with absolute freedom from smoke, flame, and escaping gas, so ruinous to interior decorations and dangerous to life, property, and health; while the light itself, in its beautiful soft radiance can not be equalled for artistic effect, by gas or any other means.

IT seems that the wing of the goddess of liberty which surmounts the dome of our national capitol has at last proved a salient point for heaven's artillery; the details of the occurrence being given elsewhere. We are not informed whether the building is properly protected by a well constructed lightning conductor, but from the description of the accident, must assume that it was not, as well as from the fact that in former years the lightning rod for public buildings had not been adopted by our government, and we have not heard of any recent change of policy in this matter.

It seems that the charge passed down through the building, killing a horse hitched near by; and distributing itself inside over the gas pipes, chandeliers, and other conductors, from which it sought a passage to the earth; this distribution evidently preventing the fatal or injurious effects which would surely have resulted from concentration. The principal discharge, and the one which proved fatal, was through the horse.

The occurrence could not have taken place had the building been properly protected by a well constructed conductor; one made of copper, without joints, of sufficient capacity to carry the heaviest charge, having good connection with all the metal work, amply grounded in permanently damp earth, and amply connected with the atmosphere above by properly formed branching points. Such a conductor has recently received the approval of the highest electrical authority in Europe after three years thorough investigation, during which practical information was collected from all parts of the world. It can be made an architectural feature of the building where prominently exposed, which need only be at the summit.

THE abstract given in another column of Lineff's paper on electric traction presents several important points which are of special interest at the present time in view of the fact that the application of electric motors to street car propulsion is attracting public attention to such a large extent. An electrician can hardly spend fifteen minutes in a street car without being questioned as to the practicability of the motor, the storage battery, the overhead or underground conductor. The slow-going horse car has fulfilled its mission and is passing away, but the question how to replace it is not definitely settled. It is seen that the locomotive is dangerous and impracticable for surface travel in towns and cities, while its noise, smoke, steam and cinders make it a nuisance for elevated roads; and its immense dead weight added to that of a heavy train requires a ponderous superstructure, which obstructs the light and air of a narrow thoroughfare, depreciating the value of property, and driving traffic, surface travel and residents from the street.

The problem of the application of steam power generated by an stationary engine resolves itself into a choice between cable traction and electric traction; and the superiority of the latter mode of propulsion being conceded, the choice lies between the conductor, either overhead or underground, and the storage battery or accumulator. An important point, one liable to be overlooked, is that the storage battery or accumulator occupies exactly the same position with respect to the application of power as the conductor; that is, it is the connecting link between the dynamo and motor; the expense of motor, dynamo, and engine being the same in each case, so that estimates can be based on the cost and advantages of the accumulator as compared with those of the conductor.

As Mr. Lineff's estimates pertain to surface traction, they require modification before being applied to elevated road traction.

WE give in another column a description of the electro-magnetic traction-increasing apparatus for which a patent was granted on the 20th inst. to Ries and Henderson of Baltimore. This method of increasing the friction between the wheels of a car and the track has been attempted before, but for some reason has not met with success. It certainly commends itself to the good sense and judgment of electricians, as something entirely feasible, and which ought to succeed, and the reason of its failure heretofore is not entirely apparent.

It seems that the method just patented contemplates the production of magnetic adhesion either for cars run by an electric motor or by other methods; and when run by an electric motor, this adhesion may be produced either from an independent source, as a battery, primary or secondary, placed on the car, or by a series connection through the motor.

The importance of the invention will be apparent when it is considered that adhesion to the track is usually produced by the dead weight of the locomotive, which often attains the enormous amount of 70 or 80 tons, and for the very lightest locomotives for elevated passenger roads is never less than five tons; the propulsion of this dead weight involves a large expenditure of energy and entails a heavy expense which might be obviated if magnetic adhesion can be made successful. It is evident on the other hand, that to produce magnetic adhesion requires a considerable expenditure of electric energy, which might prove more costly than the propulsion of the dead weight of the locomotive. There is however this in its favor that since such adhesion is required chiefly for starting the cars and on up grades, there need be no consumption of electric energy, except for these purposes, whereas the dead weight of a locomotive must be constantly propelled even when not required.

This on elevated roads is very objectionable, requiring a ponderous structure to obtain the requisite strength; and where single cars are propelled on the surface by electric motors, there has often been difficulty in obtaining the necessary adhesion for starting, and for up grades, especially when the track is slippery.

But by the method now proposed the magnetic adhesion can be increased, diminished, or dispensed with as required. It is to be hoped that it may prove entirely successful, and thus greatly facilitate the use of electric motors for street railways, and reduce the weight of locomotives now required on other railways.

Artistic Electric Lighting.[1]

By H. Swan, A. S. T. E.

There are two quite distinct and different ways of considering an installation of electric light. One, that is familiar to us, concerning volts and amperes, wires, switches and fuses, dynamos and engines, is that of the electrical engineer; the other is that of the consumer, his wife, and the interior decorator, and concerns itself primarily with the artistic nature of the fittings, the brilliancy, softness, and disposition of the lamp, and its general suitability and convenience for actual use.

I should like to point out strongly, to those who are electrical engineers, three things to consider with respect to electric lighting.

The first is, that the public—the men who want electric light in their homes—do not care one jot as a rule, how the electricity is produced; battery, dynamo, storage, or central station, is all one, except as it affects the cost. They do not care for dynamos; do not care to know about them, do not want to have them, and are only too glad to do without them—only put up with them when they desire the light and cannot get it without some generator. What they want primarily is pure light, which, when they have it, shall be as beautiful and convenient and dependable as possible.

The second thing I would insist upon is the influence of the ladies—the wives. Some men there are who will arrange, order, and see carried out their own ideas imperiously; but I am sure I only state a fact when I say that generally it is only after long and serious deliberation with the wife that such changes as replacing gas or oil by electricity are undertaken. This being so, clearly the right end to begin at in order to forward the spread of electric lighting will be the careful consideration and greater attention to actual beauty of form and arrangement of the fittings as appealing to the ladies, and to the spread of a greater knowledge of its varieties, conveniences, and beauties for household use.

Thirdly, that although it might appear that handsome effects can only be obtained by paying heavily for them, yet in reality it is not so. It stands, of course, to reason that large and handsome electroliers cost more than plain ones, but I wish to insist upon the fact that for a given cost a place may be fitted to look in every way artistic, well-lighted, and even luxuriously fitted, with exactly the same expense as, done in another way, would have given a plain, mean, and cheap appearance; and simply by the expenditure of a little taste, judgment and knowledge, as well as of wires and fittings.

Each house, and each room in the house, should be considered separately, hall, club, shop or dwelling—as an architect considers it in planning it—and not only so, but each room should be treated according to its own requirements both as to disposition and amount of light, and to harmony of decoration.

Nothing is easier than to sling a number of plain cord pendants all over a building—pleasant and easy work for the electrial engineer—and nothing has a more unfinished, mean, and irritating effect, however good the light, to anyone with the slightest artistic feeling for decoration. Think also that the light itself is decorative, the shape of the globe is lovely, the light soft and sweet—itself "thing of beauty and a joy for ever." There are houses I could name where the incandescent lamps are themselves quite one of the prettiest features of the room. Yet others again have been fitted with no sense of fitness—thick lumping holders, shades of all degrees of crude, inharmonious colors, switches looking more like a small model of a dynamo or some such piece of engineering than a piece of household furniture fitted for a lady's fingers.

The fittings should be chosen, then, light and elegant and in keeping with the character of their surroundings and their duties. There should be no heavy wrought bracket like a cantilever girder, to hold nothing heavier than a 2-inch globe of blown glass and a vacuum; the flexible cord itself should be made use of as far as possible, either alone or decorated with fancy knobs or ornaments which can be easily and cheaply made of twisted wire or spun brass balls. One of the best effects is with brackets of various designs in twisted brass or light wrought iron work—the flexible cord passing openly in and out, through vulcanite nipples where going through the metal, and suspending lamp at the end.

With the incandescent lamp, unlike gas, nothing has to be considered after the cost except the effect required to be obtained, no restrictions of placing for fear of burning or soiling or heating the things in juxtaposition, tables, walls, ceilings, tapestry, pictures—all alike are safe—only the best is to be considered. This we are not used to from constant use of gas, and sometimes very beautiful and unconventional effects can be obtained by remembering it. Let us now consider the different effects required in a good dwelling house, and how best to obtain them. I will give one or two hints of how the lighting has been fitted in some of the houses of the West End.

Drawing Room.—The principal room is generally the drawing room—here is most light required and most variety advisable. The electroliers should be open as far as possible, not too much shaded, that is, should aim at dispersion, not concentration of light. In a small room, a 5-lamp electrolier is often used, with one or two additional standards or brackets at either end. If a long room, it is advisable to have two of them. In a low room, a series of brackets round the walls is preferable; in a high one, the electrolier takes off the sense of emptiness. A device often used in good houses when gas has not been used, but candles were preferred, is to adapt the candle sconces, if handsome, with flexibles from behind the wall, and holders fitted with a brass plate in which are two small holes. Into this can be fitted the wires of a semi-circular silk shade, made on a wire frame fitted with white silk, or colored, or ornamented, according to taste. The shades are fitted to stop the light striking the eyes, and reflect it on to the wall, thus giving a soft general light over all. It is a good thing in all rooms of any pretension to run round behind the skirting a "lead and return" with sockets for movable attachments at intervals round the room, and to have one or two table standards with shades that can then be moved about as desired and connected by long flexible cords.

Switches.—The switches in the movable fittings should be in the fittings themselves. The switches to sconces on the wall should be near them, and just at the height of the hand. It is a nuisance to have to search around in unlikely corners for the switch, but for an electrolier it is often best to place the switch just inside the door, as it opens the hand finds it at once; occasionally it is placed just outside, and can be turned on before entering.

Candlesticks to be adapted are better not drilled, but a plate should be screwed or driven in the top, and the holder with attached flexible cord fastened to that. The holder should be neat, not straggling or mechanical looking, and is better electro-plated to match the candlestick. Silk shades, movable, can be adapted to candlesticks as well as to sconces.

Dining Room.—Unlike the drawing room the light here wants concentration. The dining table is the center of attraction, and a bright light on the table, shaded from the eyes, and comparative dimness at the corners of the room, is the desideratum. One or two lamps, in sconces, brackets, or standards, of 10 candle power, can be placed at the sideboards; but the chief lighting for the dining room should be enclosed in a large hanging dome or silk-covered shade spreading over the table, and capable of being moved up and down by a counter-weight arrangement. For an ordinary table, five 16 candle power lights is a good number; and it is well to arrange them with two switches, one to control two, and one to control the other three. You can then have two, three, or—with both on—five lamps on, at will. In some cases it is required to travel back and forwards as well as up and down. This can be arranged with a spring wheel, to coil up the slack, fixed in the ceiling between the rafters, if desired.

Hall.—For this you want a good general light. A 32 candle power lamp is advisable "to welcome the coming, speed the parting guest." A good effect is got by having a lantern made of upright rows of round clear glass rods arranged cylindrically with the lamp in the center. Lamps in the ceiling with cut glass are often used, and also brackets.

Picture Galleries.—These must be considered in two different ways. Do you want a good general light all over, or do you wish a bright picture line and a dim center? The latter is best for public galleries or show rooms of a large size, and can be obtained by hanging a series of 30 or 50 candle power lamps at distances of six feet to ten feet all around the gallery not far from the wall and just above the pictures, the lamps to be encircled with hammered shells of metal whitened inside, not brightened or plated, which casts strange lights. These shells should be suspended by cords, and tilted slightly at an incline to throw the light on the picture line.

For a general light, electroliers should be be used, or a series of cord pendants, but in either case all the light should stopped as much as possible from going upwards to the ceiling, and be reflected on the walls. They may be obscured for softness.

For a large picture gallery, 50 or 100 candle power lamps are useful. A useful addition to a picture gallery is a large reflector on a standard with wheels for throwing light on particular pictures with a 50 candle power lamp. Single noted pictures are often fitted with their own bracket coming out of the top of the frame and shielded with a shell to throw the light wholly on the picture; it should be whitened or gilded inside.

Ball Rooms.—There are so many different arrangements for ball rooms that it is difficult to say which is best; but for large and high rooms use lamps of higher candle-power. Remember too, that while much light is required it is wanted soft and harmonious and not too brilliant. Ladies wish to appear at their best, and a too glaring light is not good. An American furnisher has gained society's applause and gratitude by modifying the too brilliant glare of the incandescent filament into delightful softness and harmoniousness by a very simple means. He envelopes each bulb in a small bag fitted with an elastic round its top and made of straw-colored silk.

Bed Rooms.—The lamps should be available for giving a good light for dressing by, and should be susceptible of being turned on or off from the bed. A table lamp for reading is also required sometimes.

Stairs and Passages should have plain fittings, as a rule, and opal reflectors.

Kitchen and Basement.—Opal reflectors often get broken here, tinned and enamelled iron ones are more advisable. A movable one on a handle near the fireplace, for introducing into pots, to look at the contents, is very useful to the cook.

Counterweight Pendants.—These are very useful and convenient, and can be used in all sizes and designs, plain or ornamental. Care should be taken that the wheel, or running surface, where the double flexible touches on, is not metal, but vulcanite or ivory—or faced with some insulating material; the hook which keeps the cords together should also be of insulating material.

Cut glass has a very fine effect, but is costly, and requires constant cleaning to keep brilliant.

Lamps.—A great deal more can be done than is usually the case by varying the candle power of the lamps to suit the different situations. It is too often the case that 16 candle power lamps are used all round, and floods of light are expended in corners, passages, lavatories, etc., which had much better have had 10's or even 5's; more light being reserved for where it could be better employed. A 10 candle power lamp in a double-faced lantern, let into the wall between two lavatories, is often quite enough, and will sometimes efficiently replace two 16's or four times the power.

Thirty, 50, and 100 candle power can much more often be used with advantage than is yet usual. Four 50's give an effect equal to, or better, in a large space, than that of twelve 16 candle power; and, of course, at a cost for renewal of 20s, instead of 60s. One 100 candle power lamp will light a large shop window splendidly at a very moderate first cost; but it is necessary to have specially made holders for these high candle power lamps, and a solder contact is better than the contact of two round wires—which, remember, is mathematically no more than a point—to carry 4 or 5 amperes of current.

1 Read at the City and Guilds of London Institute—Old Students' Meeting.— *The London Electrical Engineer*, March 9th.

Electric Traction.

In a recent discussion by the London institution of civil engineers A. Lineff gave some interesting facts and statistics in regard to the important practical question of electric traction on tramways, showing the comparative advantages of the three systems known respectively as the overhead conductor, the underground conduit conductor, and the accumulator systems, basing his calculations on a line one mile long, with two cars, carrying 46 passengers at an average speed of six miles an hour.

With either of the conductor systems, he said, this can be easily accomplished with a 30 ampere current, and an electric pressure of 250 volts. The cost of the overhead conductor he finds to be £200 per mile, and the underground £1,500. With accumulators he estimates a weight of 4½ tons of cells per car, 9 tons for the two cars, at £60 per ton, £540; and adding 50 per cent. £270, for increased cost of cars, motors, etc., the cost of accumulators as compared with cost of conductors would be £810, or about £800. And as the accumulators simply replace the conductors, leaving the expenses of generating plant and permanent way the same in each case, he considered this so far a fair comparison. Assuming interest and depreciation of conductors at 10 per cent. and of accumulators at 30 per cent. gives 20 per cent. greater depreciation for accumulators. And to put both systems on an equal footing as to depreciation, the actual cost of accumulators must be increased by the capitalized difference of depreciation of the two plants. One thousand pounds invested in conductors would annually depreciate at the rate of £100, while the rate of depreciation of accumulators would be £300, treble that of conductors.

With increased traffic the capital outlay for the conductor system would increase only nominally by the extra weight of copper to be added to the conductors, for which £25 per mile for every two additional cars, 30 amperes, would be ample. But for accumulators the cost must be multiplied by the number of cars.

The following table gives the respective cost in pounds of the three systems, the overhead conductor system being know as A, the underground conduit as B, and the accumulator as C.

Cost of Conductor and Accumulator Plant.

Length	Two Cars.			Four Cars.			Six Cars.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.
1 mile	200	1,500	2,400	225	1,525	4,800	250	1,550	7,200
2 miles	400	3,000	2,400	450	3,050	4,800	500	3,100	7,200
3 miles	600	4,500	2,400	675	4,575	4 800	750	4,650	7 200
4 miles	800	6,000	2.400	900	6,100	4,800	1,000	6.200	7.200

Length.	Eight Cars.			Ten Cars.		
	A.	B.	C.	A.	B.	C.
1 mile	275	1,575	9,600	300	1,600	12,000
2 miles	550	3.150	9,600	600	3 200	12,000
3 miles	825	4,725	9,600	900	4,800	12,000
4 miles	1,100	6,300	9,600	1,200	6,400	12,000

From the above foregoing facts and figures he draws the following conclusions: (*a*) that wherever an aerial conductor could be used, the accumulator system could not compete with it, however small the traffic, if the length of the line did not exceed, say, ten miles; (*b*) that for heavy traffic the accumulator system could not compete even with the expensive underground continuous conductor; (*c*) that in each case, where an increase of traffic might be expected, the continuous conductor was preferable, as a trifling extra outlay in copper imparted great elasticity to the line with regard to the number of cars which could be worked on it; (*d*) that the accumulator system could be advantageously applied in towns on comparatively long lines with a small number of cars running, which was, of course, an exceptional case.

He then showed the defects of the London Metropolitan underground lines, operated by steam, which may be briefly summarized as follows: Vitiated air, limited amount of useful work as compared with expenditure of power, the dead load of locomotive and train of cars being 139 tons and the average load of passengers 27 tons, or about 2.25 tons per train mile, making the paying load only 1.6 per cent. of the entire load per mile; with fewer trains and increased size, the results would be crowded cars during one part of the day, and empty during another part, slow service, increased waste of power, and wear of track. With an electric plant, the aspect of working a railway would be entirely changed. The power would be generated at a central station or stations, and therefore under most economical conditions, with the least expenditure of fuel, attendance, and stores. The trains could be reduced to one or two cars, starting in the busy hours of the day at intervals of one minute, or even less, and of four to five minutes during the remaining hours. In fact, the whole train service could be arranged to a nicety in accordance with the average requirements of the traffic. A separate heavy locomotive would be useless, as the motor could be fixed under the car or on the bogie; this alone would increase the efficiency, or the ratio of useful weight to dead weight, to at least five times its former value. The work of driving and firing would be simply reduced to the turning of the switch in the guard's compartment, and therefore a great saving of wages would be at once effected. Moreover it must be remembered that a dynamo or motor was kinemetrically one of the simplest mechanisms, having merely two journals with a rotating shaft and no reciprocating parts or motion of any sort. As a consequence, the cost of repairs of an electrical plant must be much less than with locomotive power.

The introduction of electricity as a motive power on the Metropolitan underground railway would alter the useful work thus: A train of two empty carriages, 20 tons; motors, etc., gear, 2 tons; full paying load, ninety passengers, or 6.6 tons. The efficiency with full load would be $\frac{6.5}{22}$ = 30 per cent., half load $\frac{3.3}{22}$ = 15 per cent., quarter load $\frac{1.65}{22}$ = 7.5 per cent., as compared with 1.6 per cent., the present ratio.

Long Distance Telephony.

M. J. Banneux, chief engineer of the Belgian telegraphs, recently read a paper before the Belgian society of electricians on overhead circuits for long distance telephony. An abstract follows: With a single wire and earth return, it is impossible to avoid the noises due to earth currents, induction from adjacent wires, and currents taken up from other circuits having earth returns; hence, a complete metallic circuit is an absolute necessity. Instances are common of currents taken up from other circuits, where the trouble could not be ascribed to induction or other causes. At Brussels a telephone line at right angles to a telegraph line made earth 50 yards from a Morse instrument, yet every Morse signal could be heard on the telephone line. Two lines from Ostend connected to the same earth plate extended, one to Dover and the other to Brussells, and yet through this earth connection conversation over the one line was heard over the other. A telegraph and telephone line may have but a single post in common, and yet in damp weather the telegraph signals are often heard over the telephone line. The most effective method of stopping cross-talk due to leakage is by fusing good insulators and joining all their iron supports to an earth wire at each post, most of the leakage then passing to earth instead of into the other wires.

Induction betwen adjacent wires is the eyesore of the telephone, though cross talk attributed to it is sometimes due to leakage. This induction is represented approximately by the formula $m = 2l(\log\epsilon.\frac{2l}{d}r)$, where m is the coefficient of mutual induction, l the length of the parallel wires, and d their distance apart. Telephonic and telegraphic induction, though of the same nature, should be treated separately, on account of the different kind of remedy which each requires. Every Morse signal, for instance, gives two currents on an adjacent telephone wire, a reverse on making and a direct on breaking, and consequently two clicks on the telephone, so that a message can be read as easily as from the sounder direct; and with a Hughes, or an automatic instrument, this effect becomes still more prominent. This inductive effect from a parallel wire, running even a short distance, is very annoying, and far more so on long parallel lines in constant operation, often rendering telephonic transmission impossible. The experiments in 1883 on a copper and steel wire, with earth return, between New York and Chicago, 1,058 miles by wire, 725 direct, demonstrated the possibility of practical telephony for that distance, when parallel lines are not in use.

On parallel telephone lines connected to the same posts and having earth returns, conversation on one line is perfectly audible on the other, hence such lines should be on separate poles. No advantage is gained by crossing earth return wires, except when crossed at exact right angles. Prof. Thompson's proposition to make the transmitter ten times more powerful and the receiver proportionately weaker, would reduce telegraphic induction, but not telephonic. Van Ryssel-berghe's method of lengthening the makes and breaks of the telegraph signals is the only practical method of reducing telegraphic induction to such a minimum that its effect is inappreciable, but this does not eliminate telephonic induction, which can be done only by a complete metallic circuit so arranged that the sum of the inductions of adjacent telegraph or telephone wires shall be exactly the same on both wires of the circuit. This method was patented by Bell in 1877, and its efficacy proved by Hughes in 1879, and subsequently applied by Brooks, of Philadelphia, to cables by twisting. On a line of poles carrying one telegraph wire and a telephone line looped as above, equal induction on both wires of the loop may easily be obtained by running the telegraph wire parallel to the others and equi-distant from them. But as telegraph wires are usually numerous on a line, and vary in number on different sections of it, this equi-distant arrangement is impractical, and it becomes necessary to twist the wires together in long helices similar to cables.

The Paris-Brussels line, constructed in December, 1886, is a complete metallic circuit, 149 miles long, the Belgian 48 miles being phosphor-bronze, and the remainder silicon-bronze; it has the very best insulation, is run on top of the poles, a four-branch bracket being used, and all vertical crossings taking place at the posts, every thirtieth or thirty-fifth post being used for this purpose, and between these occur horizontal reversals, backward and forward at every sixth or seventh span. This line has been in operation for a little more than a year, and gives the best satisfaction.

Electric Light and the Gas Engineers.

At the annual meeting of the New England association of Gas Engineers in Boston last month, the president, John P. Harbison, of Hartford, in his opening address spoke of electric light in this way:

"The subject of electric light continues to be an interesting one. The past year has witnessed considerable progress made in the introduction of the light, mostly of the incandescent type; but I have yet to learn of any advance in the reduction of the cost of production of the light—or in correct business methods of introducing it. The business is now, as in the past, conducted in a sort of 'go as you please style.' What was the amount of your gas bill last year? We will furnish you with the electric light for the same amount; you may use all you wish, and no charge will be made for introducing or lamps; they too frequently succeed in obtaining customers, as might be expected, in that way. Later on, we may be able to obtain some reliable information as to the profits made in doing that kind of business."

Frank Ridlon ex-president of the Boston Electric club was introduced during the session and made the following little speech:

"I have, indeed, to thank you for the kind invitation issued to me to attend the opening session of this convention. I can not but feel that this is a movement in the right direction. As one interested in the electric light business, it has been my earnest endeavor for the last three or four years to bring about a unity of interest between gas and electric light companies, and I am gratified to see to-day there is a probability of success in this direction. We are all engaged in meeting the demand of the public for some kind of light, and I do not know why any of us should take it upon ourselves to decide which light the public shall have. Let them decide it for themselves, and we will be very glad—that is, meaning the

combined gas and electric light company—to furnish them anything they desire, they paying a fair and proper price for the same. I do not think there is any occasion for us to make any public attacks upon each other. We are all a pretty good set of fellows, and when we come together we find it out. We have been looking at each other at a distance until recently; but when we come together occasionally, as we have been doing in the past year, and are able to shake hands with each other, we find, as gas men and as electric light men, that our interests are so nearly identical that it will be for our mutual interest to work together in harmony."

Lightning at the Capitol.

Lightning disturbed the occupants of the capitol building at Washington last week. The Chicago *Daily News* tells the story in these words: "The justices of the supreme court were so shocked that they rose from their chairs, but settled back again at once, looking as if they had done a childish thing. In the sub-basement an engineer in charge of the electric light apparatus was knocked out of his chair, and nearly all the electric lights were extinguished. In the senate an unimportant bill was under consideration and no one happened to be on the floor except the reading clerk, who was reciting its lines in singsong tones. He stopped as the crash fell and looked around in a dazed way, whereupon Senator Manderson, who is an old soldier and has heard similar noises on the field of battle, arose as coolly as if nothing had happened and offered an amendment.

"In the house of representatives consternation reigned for a few minutes. The house was considering the eight-hour rebate bill. Mr. Lane was speaking. The galleries were well filled and the house was attending with more than usual interest to the proceedings. Just as the hands of the clock marked 2 there was a vivid flash and a peal of thunder. For an instant the proceedings stopped and every member started in his seat. Some jumped out of their seats and all looked up as if expecting the roof to fall upon them. People in the galleries got into the corridors as quickly as possible. In the press gallery a ball of fire as big as a man's two fists flashed on the switch-board and all the wires but one were cut off."

Equipment of The Paris International Electric Laboratory.

A foreign exchange gives a full description of the Paris international electric laboratory and its equipment, It is a one story building and the various departments are equipped as follows: The machine room contains a 20 horse power Otto gas engine, and, connected with it by a counter-shaft, is a 20 horse power steam engine, placed in the yard. The electric machines are a 70 volt, 300 ampere, constant current Gramme dynamo, an alternating current Gramme dynamo, and 100 light Edison dynamo; connected with which are two switch-boards, one for the constant currents and the other for the alternating.

The photometric room contains a large Bunsen photometer, with a 13 ft. scale and the accompanying standard lamps; and a Dumas and Reynault balance for weighing the consumption of oil.

The electro-chemical laboratory is equipped with a large number of instruments for obtaining measurements of the electric current by the deposition of silver and other metals, a subject in which the superintendent, M. de Nerville, acquired extensive experience in connection with the determination of the legal ohm.

The calibrating room contains standard mercurial resistances, three Duprez d' Arsonal galvanometers, and one Mascart electrometer. The testing of commercial ammeters and voltmeters belong to this department.

The cable testing room contains a full supply of apparatus, comprising Wheatstone bridges, Thomson mirror galvanometers, Duprez galvanometers, a Carpentier dead beat electrometer, and a Leclanche 100 cell battery.

In the main hall are two Thomson graded galvanometers, a small hand Gramme dynamo, a Wimshurst induction machine, a Gaulard & Gibbs transformer, and a 1 horse power Gramme motor, driving a Romilly pump. This hall is to be used for conferences and special experiments.

North Side Cable Company's Electric Service.

The North Side cable company of Chicago possesses an excellent electric service and a visit to the electric light and motor stations will repay any one interested in electrical matters. William Watts, the electrician in charge, explained to a representative of the WESTERN ELECTRICIAN the details of the systems. The motor station is located at the north end of the La Salle street tunnel. The motor, is a Thomson–Houston, twenty horse power and is employed to drive a seventy inch Sturtevant fan. The fan is operated on damp, muggy days to ventilate the La Salle street tunnel through which the cable runs. The fan, which makes 720 revolutions per minute, works on the exhaust plan. Pure air is admitted to the tunnel by means of six registers.

The electric light plant is located at the engine house. The dynamo which is a fifty light machine, of the Thomson–Houston make, furnishes the current for the lights in the tunnel. It is provided with the newest appliances for the regulation of load. Mr. Watts said he was able to cut out forty lights without affecting in the slightest degree the action of the dynamo. A second dynamo is employed to generate current for the motor.

There are 40 arc lights of 2,000 candle power each and 12 incandescent lights of 65 candle power in the tunnel. These latter lights are run from the arc circuit. These lights constitute the load of the dynamo at the engine house. The wires are laid in cables underground from the dynamo room to the tunnel entrance.

In the conduits of the street cable a wire is strung to provide communication with the engine house. At each manhole is a numbered box. If trouble is experienced with the cable, the conductor jumps from the car and sends in a call to the engineer. Four signals are employed. The manholes are constructed so near together that a conductor can always reach the signal box within thirty seconds.

Practical Use of an Electro-Magnet.

The following description of the practical employment of the electro-magnet is taken from the Pittsburgh *Press:*

"S. T. Wellman, the superintendent of the big steel works at Cleveland, conceived the notion some time ago that a large electro-magnet, suspended by a chain from a crane, could be employed very profitably for lifting masses of iron. Not being an electrician, he did not see his way to carrying the thing out practically. Mr. Berry, an electrical engineer of Pittsburgh, being on the spot, volunteered his advice and superintendence. Together they brought the thing to completion last week, and it is now working with great perfection.

"For the construction of the electro-magnet to be experimented with, two bars of soft iron were taken each being 14 inches long and 3 inches in diameter. They were wrapped with a multitude of strands of No. 14 B. & S. gauge-covered wire. To combine the two separate magnets thus formed into one, they were linked together on top by a third soft iron bar, square in the cross section.

"For trial of the magnet at portative work it was suspended by a rope from a pneumatic crane. Rope was used, as it was found that a chain became magnetized and did not act very well. The current power sent through the wire to induce the magnetism was that of 5½ to 6 amperes. It was found that a weight of 800 pounds could be lifted up handily, and, by shutting off the current and lowering the magnet deposited anywhere very easily. * * * At one part of the factory where this electro-magnet has been put up, fourteen or fifteen Polacks have been wont to be kept employed at this work. They are now in the position of *Othello* in the matter of occupation, the magnet picking up two or three billets at a time and depositing them in a car.

"If the thing works permanently, as it appeared to be working when Mr. Berry left Cleveland, it looks as if one boy would be able to do the work of a gang of men. His duties will be those of lowering the magnet from the crane on to some billets, turning on the current, swinging the magnet around to the top of a car, cutting off the current, and bringing the crane back to its first position. The crane used is one of a very superior class, being adapted to turning in any possible direction almost, at a slight movement from a pneumatic valve. The turning off and on the electric switch, of course, would require no expenditure of energy that would be worth speaking of at all. It is intended to construct an electro-magnet of softer and more appropriate iron than that of which the first experimental one was made. The amount of current, also, will be arranged so that only a portative capacity of 150 pounds or so, at the poles of the combined magnet, will be produced."

CORRESPONDENCE.

New York Notes.

NEW YORK, March 24.—The meeting of the American Institute of Electrical Engineers which was announced for the 13th inst., was not held, on account of the blizzard. The paper which was to have been read by Lieutenant Patten, will form part of the programme at the general meeting of the institute, to be held May 16th. The next meeting of the institute is announced for April 10th, when it is expected that a paper will be read by John W. Howell, of the Edison Lamp company.

The telegraph and telephone companies in New York, whose wires have been taken down from poles and put in the subways, have made no attempt to remove their poles, and hundreds are now standing useless in the streets. The act creating the Board of Electrical Control made no provision for the disposition of abandoned poles, as it was supposed when the subway laws were passed, that either the electrical companies would find the poles of sufficient value to transfer them promptly, or else that the city authorities would remove them as a public nuisance. But neither of these suppositions has proved correct, and a bill has been introduced in the legislature authorizing the Board of Electrical Control to remove poles and wires not in actual use along the line of completed subways, after due notice to the companies owning them. If the measure is passed it is not probable that the board will be obliged to take down many, for such poles as are used in the principal streets of New York, where the subways run, are too valuable to be lost by the companies owning them.

The salaries of the employes of the Electrical Subway commission are paid by the state controller, who is authorized to collect the amount from the companies whose wires occupy the subways, but as the constitution of the board applies to this city only, there has been considerable discussion as to whether the power of appointment belongs to the state or to the city civil service commission. Attorney General Tabor gave his opinion on Tuesday of this week, that the commissioners referred to are state officers, in the sense that they are agents of the state rather than of the city of New York. It is thought that no examination of the present employes will be made but that applicants for positions hereafter will be made by the state civil service commission.

It is a pity that anything so tiresome as the following, which is taken from a Brooklyn paper, should come from so near home: "One of the latest fads is the electric kiss, which originated in Boston, and was introduced here by a Brooklyn young lady who had attended an ante-Lenten party on Beacon Hill. It is thus described by a young lady participant: 'The ladies and gentlemen range themselves about the room. This being leap year, the lady selects a partner, and together they shuffle about on the carpet until they are charged with electricity, the lights in the room having first been turned low. Then they kiss in the dark, and make the sparks fly for the amusement of the onlookers. Oh, the shock is delightful. I have never been to but one electric party, but I understand that after a young lady has played the game for a while, it is impossible to give her a shock. Probably the gentleman don't shuffle his feet hard enough on the carpet. Gracious! I'm afraid I should wear the soles off my shoes.' The electric kissing parties are growing rapidly into popularity, in spite of this being leap year."

The Commercial Cable company has re-elected its old board of officers, as follows: President, J.

W. Mackay; vice-president, H. De Castro; second vice-president, C. C. Brown; Treasurer, E. C. Platt; secretary and general manager, G. G. Ward.

The New York telegraphers will give their annual performance and reception at Turn Hall, on Tuesday evening, April 3d. On this occasion will be produced the comedy drama, "Among the Breakers," in which many professionals will participate.

The electrical committee of the Philadelphia common council, has recommended that the electric lighting of the city be augmented by 230 new lights, in various parts of the city.

The ferry house and depot of the Pennsylvania Railroad company at the foot of Cortlandt street, had a narrow escape day before yesterday. The building is lighted by electric lights, and poor insulation of one of the wires started the woodwork ablaze. Fortunately the fire was discovered and put out after having caused damage to the extent of less than $50.

The pneumatic tube system of the Western Union Telegraph company is complained of as seriously injuring the health of employes. The tubes running between the down town and up town offices of the company, become charged with sewer and other gases, so that every time they open they empty volume after volume of these deadly gases into the rooms. An attendant states that nine men out of ten who attempt to work in the basements succumb to the foul surroundings. The health officers of the city have been asked to institute an investigation.

The Pennsylvania Railroad company is said to be contemplating the use of electric motors on the Atlantic City street cars.

The bill substituting electricity for hanging in the execution of criminals, has been ordered to a third reading in the Assembly, but it has been amended so that religious ceremonies may be held within the prison walls, the immediate relatives of the dead being present.

Alex. Duncanson, a lineman in the employ of the Metropolitan Telephone & Telegraph company, fell yesterday and broke his leg while climbing a pole at First avenue and Twenty-second street. A.

Kansas City Chat.

KANSAS CITY, March 24.—The statement sometimes made that Kansas City is poorly lighted is one that cannot stand in the face of the following figures giving in detail the number of electric lights in use and the places where they are used: The Kansas City Electric Light company have two power stations, but the main one, located at the corner of Santa Fe and Eighth streets, stands first in the number of lights supplied and size of station. The numerous other stations are isolated. The foregoing company have at the present time a capacity of 850 arc and 2,500 incandescent lights; 675 arc and 2,000 incandescent lights being in use at this writing, leaving a surplus of 175 arc and 500 incandescent lights. Power is furnished by nine engines of following make: 2 Hamilton-Corliss; 2 Buckeye and 5 Ide, ranging in power from 80 to 250 horse-power. The boiler capacity is upwards of 900 horse-power. The power house is of brick 50 x 110 feet and three stories in height with a chimney 125 feet high.

The other plants are as follows: Warder Grand Opera house, 1,500 incandescent lights, Thomson-Houston system;

Nelson & Weller building, 1,000 incandescent and 20 arc, United States system;

Gillis Opera House, 450 incandescent, United States system;

Post Office and Custom House, 421 incandescent, United States system;

Armour Packing company, 650 incandescent, 120 arc, Fort Wayne Jenney and Brush systems;

Landis Hotel, 700 incandescent, Edison system;

Swift Packing company, 525 incandescent, 20 arc, Fort Wayne Jenney system;

J. Dold & Sons, 600 incandescent, 20 arc, United States system;

Abernethy Furniture company, 150 incandescent, Brush system;

Centropolis Hotel, 600 incandescent, Edison system.

Whittich & Penfield, 150 incandescent, Hawkeye system;

Metropolitan Cable company, 80 incandescent, Edison system;

Kansas City Cable company, 75 incandescent, 25 arc, Thomson-Houston system;

Grand Avenue Cable company, 150 incandescent, Edison system;

Browning, King & Co., 20 arc, Excelsior system;

G. T. Smith & Co., 23 arc, 32 incandescent, Brush system—by the way it is the oldest plant in the city;

Water Works company, 120 incandescent, Hawkeye system;

Times building, 450 incandescent, Edison system.

From the above figures one can readily see that Kansas City is not so poorly lighted as might be, as most of the total number of arc lights 923 are outside lights, while the majority of the total number of incandescent lights 9,653 are inside.

Besides the above there are two large companies, one already formed and now constructing lines, and another about to be formed, which in a short time will add greatly to the facilities for lighting our growing city.

The Holmes Electric Protective company, of New York, have arranged with the Home Telegraph & Signal company to operate their burglar alarm system.

The police commissioners have given authority to the Mooney & Boland patrol, under the direction of the Mooney & Boland Detective agency to patrol any and all streets within the limits of the city in connection with their electric signal patrol boxes.

The matter of underground wires in Kansas City was a short time ago referred to the public improvement committee by the common council. Last night, at a special meeting of the common council, the committee reported, advising that the ordinance be not adopted, but after considerable debate, the ordinance was carried by a vote of 11 to 4. The question in regard to system to be used is left with the mayor, city engineer and city comptroller.

The Kansas City Electrical works are now wiring the new quarters of the National bank of Kansas City for incandescent lighting; also a perfect system of call bells from desk to desk. The same company are now placing in the Excelsior Springs hotel, Excelsior Springs, Mo., a 160 number Porter electric messenger and guest call. This system is as near perfection as can be attained, and a description will undoubtedly be interesting. The office annunciator consists of a dial within a dial, the larger dial bearing the numbers of the rooms in the hotel, while the smaller dial bears the same words as the boxes placed in each room. These boxes are similar to a messenger call box, bearing 25 different calls, among which are such as, "ice water," "coupe," carriage," "baggage," "mail," "porter" etc. By turning the pointer to any desired point and releasing it, it will register on the small dial in the office what is wanted, while the pointer on the larger dial registers or indicates the number of room. This system is being used in a large number of the leading eastern hotels, prominent among which is the Hoffman house, New York City. This system is under the supervision of W. H. Woodring.

Mr. Walker, of the Electric Light company of Leavenworth, Kansas, was in the city this week. His company are about to increase their facilities for incandescent lighting.

The Electric Construction company have secured the contract for wiring the new Board of Trade building for the Edison system. Okonite wire will be used throughout. About 1,500 lights will be used. The same company have also received the contracts for wiring the American Bank building and the new quarters of Kansas City club. The system to be used in the American Bank building has not as yet been decided on but it will be wired for the Edison system.

The following telegram was sent to the Hiawatha Electric Light company by its committee who visited Kansas City to inspect the New York Accumulator company storage battery system and embraces about all electrical phrases pertaining to the system:

"Capacity of electrical accumulators are equal to electromotive force of amperes divided by volts, plus condenser, ohms and hydrometer. Effects due to the rheostat." D.

From the Crescent City.

NEW ORLEANS, March 22.—The Crescent City lays claim to the largest electrical plant in the world. The Louisiana Electric Light and Power company now operates 1,500 arc lights and 350 miles of wire have been strung. The company's plant, although occupying half a square, is hardly large enough for the requirements of the business.

The engine room is 90 by 60 feet, and contains two Corliss engines, 28-inch cylinder diameter, with a 60-inch stroke each, and a single Corliss engine, 32-inch cylinder diameter, with a 60-inch stroke. The belt wheels are 24 feet in diameter. The single engine is rated at 800 horse power, and others at 1,200 horse power each. The belt for the pair of engines is 5 feet 3 inches in width and 165 feet long; that of the single engine is 4 feet 3 inches in width and 158 feet long. There are two condensers used in connection with the driving power to increase its force and decrease the use of coal. There are two boiler feeders, each pumping 400 gallons of water per minute. The pump that brings the water from the river has a capacity of 800 gallons a minute, and is used in supplying the various purposes for which water is required about the building. The boiler room is 180 feet in length and 55 feet wide.

There are three batteries of boilers of five boilers each, connected to an 18-inch steam main running from the engine room. Each boiler has a capacity of 100 horse power, which may be increased 25 per cent by the use of the condenser or air pump. The steam trap is connected with the steam main, so as to get rid of all condensation and return the same to the boilers.

One battery of boilers has been so constructed as to be available for the combustion of crude petroleum as fuel. A large tank for the oil supply is placed in one corner of the room, raised to a sufficient height so that the oil will flow easily by its own weight. Around the tank is a four-inch water space as a precaution against fire. A series of pipes running along the front of the furnace is connected with the oil tanks. The oil, in passing into the furnaces, flows through a burner so constructed as to have three channels—one for steam, one for air, and one for oil. When passing through the burner the heat of the steam generates gas, which rushes into the furnaces. The heat is tremendous, the combustion perfect, without the least smoke, and all the possible amount of steam is readily procured. The lighting up of the immense furnaces is the simplest and most cleanly process imaginable.

The machine shop contains a forge, lathes, milling machines, shapers, planers, boring machines, drilling machines, and tools required in the manufacture of electrical apparatus of all kinds. The men employed in this department are all expert electricians, except the apprentices who are learning the trade.

In the dynamo room there are fifty-four dynamos, all of which are of Fort Wayne Jenney manufacture. Then there is a Slattery alternating dynamo, intended to be used for the incandescent system, which will be capable of lighting 1,800 lamps, which is also manufactured by the Fort Wayne Jenney company.

The officers of the company are: President, Jos. Simon; vice-president, John Nelson; general manager, Maurice J. Hart; secretary and treasurer, F. S. Neustadtl; superintendent, A. W. Reiling; chief engineer, F. Chas. Meyers. D.

From the Pacific Slope.

SAN FRANCISCO, March 22.—Matroni Justici has brought an action against the Pacific Bell Telephone company to obtain $200. The plaintiff alleges that his horse received a shock from a detached wire which has permanently disabled the animal.

The steamer Umatilla is lighted by two Edison dynamos. Owners have found that it pays to employ electric light, as steamers thus illuminated become far more popular.

The Western Union Telegraph company some time ago served notice on the Sunset Tele-

phone company, stating that the wires of the latter company must be removed from the poles of the Western Union by January 31st. As the order was not complied with, the Western Union gang removed the telephone wires from the poles March 12th and left them on the ground. The Alameda trustees have granted the Sunset company a franchise, giving them permission to erect poles with the proviso that the wires will be buried when the board makes the order.

Twelve arc lights illuminate the San Quinten State prison.

Hotel Del Coronado at Coronado beach is completely lighted by electric light. A new building containing 350 rooms is to be erected. It will also be illuminated by electricity and will be furnished with other electrical apparatus.

A trial trip on the San Jose Electric Motor road was made on the 15th instant. Messrs. Bishop and Rich, owners, and Mr. Fisher who controls the patents superintended the test which proved entirely satisfactory. The San Jose council on the 19th granted franchises to three electric light and motor companies on condition that they lay their wires underground.

The Berkley, California, Electric Light company started on the 18th. A mass-meeting was held to celebrate the opening. M. B. Curtis of "Samuel o' Posen" fame kept the meeting in good humor. Three cheers were given for the Jenney Electric Light company of Indianapolis.

The board of trustees of Riverside, has granted a franchise to a motor company.

The Carson City electric light plant was opened on the 3d instant.

The Honolulu, Hawaii, is putting in an electric light plant. Power will be obtained from the city water works. S.

Burrton, Kansas.

BURRTON, KANSAS, March 15.—While the attendance at the electric light test and banquet on last Friday evening was not as large as was anticipated, still what was lacking in quantity was made up in quality. There were present from abroad: Captain Shields, editorial writer on the *Eagle*; D. C. Collier, of the Wichita *Beacon*; Professor Norton, of the Newton *Republican*; H. S. Gilhams, of the Halstead *Herald*; S. J. Lemere, representing the Nickerson Electric Light company; C. R. Wise, engineer of the 'Frisco; O. H. Bentley and H. L. Jackson, of the Kansas Midland, and several others.

Soon after the guests arrived, W. F. Stocker took them in charge and cleverly explained the accumulator system. Afterwards the entire party were shown the dynamo and the mechanical devices connected therewith. Later, the newspaper men repaired to the *Graphic* sanctum, where they took notes. After taking an inventory of the *Graphic* office, the party took up the line of march to the Radix house, where about seventy-five townspeople had assembled.

Supper was announced, and the tables were a sight to see. They fairly groaned under every delicacy that could be obtained. A few short speeches followed, after which business commenced and, it is safe to say, all did ample justice to the good things. After supper, speeches were made by Mayor Johns, W. L. Daily, L. Cone, O. H. Bentley, C. R. Wise, Professor Basell, W. H. Wilson, Captain Shields, Professor Norton, C. D. Collier, Professor Gilhams, W. F. Stocker, R. S. Thompson, and others.

After supper, W. A. Van Arsdale conducted the visitors to his residence, which was beautifully illuminated for the occasion and showed the different styles of brackets, chandeliers and adjustable lamps in use. After this exhibition, the party repaired to the *Graphic* office, where some ingenious electrical devices of Mr. Stocker's invention were shown, and several photographs were printed by the arc lights. Still later, the newspaper men were cornered and some some negatives taken by electric light. As the hour was then late, the party adjourned to the hotel where a social time was had. D.

From Salt Lake City.

SALT LAKE CITY, Utah, March 24.—At the last session of the Utah legislature a bill was passed entitled, "An act providing for the incorporation of cities." Two sections under Article IV, the 18th and 19th are of interest to the electrical fraternity, and are given in full:

"SECTION 18.—To make contract with and authorize any person, company or association to construct gas works, electric or other light works in said city and give such persons, company or association the privilege of furnishing light for the public buildings, streets, sidewalks and alleys of said city for any length of time not exceeding three years.

"SECTION 19.—To provide for the lighting of streets, laying down of gas pipes and erection of lamp posts and to regulate the sale and use of gas and electric or other lights, the charge therefor and the rent of gas meters within the city, and to regulate the inspection thereof; to prohibit or regulate the erection of telegraph, telephone or other electric wire poles in the public grounds, streets or alleys, and the placing of wires thereon, and to require the removal from the public grounds, streets or alleys of any or all such poles and the placing underground of any or all telegraph, telephone or electric wires." S.

From Jackson.

JACKSON, O., March 24.—The contracts for the electric lighting, which have excited such unusual competition, have been awarded as follows: Thirty arc light dynamo, lights and wiring, Thomson-Houston company; two 300 light incandescent dynamos, with lamps and wiring, Edison Electric Light company; engines, Ball Engine company, Erie, Pa. D.

From Janesville.

JANESVILLE, Wis., March 26.—Representatives of the Edison Electric Light company are in the city endeavoring to secure a franchise for the introduction of their system. They offer to put in a $30,000 plant within three months after the franchise is granted. C.

THE ELECTRIC LIGHT.

The Progress Electric Light & Motor company of Mobile, Ala., lights that city with 181 arc lamps at a cost to the city of $17,970 per annum.

A press dispatch from New Orleans dated the 24th reads: The entire plant of the Southwestern Electric light company was seized to-day on a writ issued by the United States court on judgments in favor of the Westinghouse company, aggregating $32,000. The concern has further liabilities of $50,000 bonded indebtedness and $4,000 accrued interest, making a total of $86,000. The estimated value of the plant is $90,000. The stock of the company is so widely distributed that no one meets with a heavy loss.

The Eureka Kansas Electric Light company has been incorporated with a capital of $25,000. A. S. Van De Mack is president.

The Williamstown, Mass., Electric Light company has been organized with a capital stock of $15,000.

The West Side Electric company has been organized at Saginaw, Mich., by F. C. Stone and others, with a capital stock of $30,000.

The Muncie Heat, Light and Power company, of Muncie, Ind., has been incorporated by J. Boyce and others, with a capital stock of $50,000.

The Aurora, Ill., Electric Light and Power company has been incorporated with a capital stock of $15,000. The incorporators are Wynn Meredith, William George and F. B. Haviland.

Electric lights have been put in the Paris morgue with an idea of increasing the effect produced upon murderers upon being confronted with their victims. Under the effect of the light the "confrontations" are expected to be much more effective.

It has been stated that experience in the palace of the Czar at St. Petersburgh, has proved that electric light had an injurious effect on plants used in the decoration of one of the rooms. Dr. Siemens lighted his greenhouse by electric light and discovered no evil results.

City Electrician Barrett, of Chicago, estimates that the cost of operating the river electric light plant will be $50 per arc light per year.

The Defiance Electric Light company of Defiance, Ohio, are now running a Western Electric arc plant of 110 lights, and have just ordered a United States alternating plant of 500 16 candle power lights.

The International exhibition at Melbourne will be lighted by 800 arc lights of 2,000 candle power each and 3,000 incandescent lamps of 17 candle power each. The Anglo American Brush Electric Light corporation has contracted with the Australasian Brush Electric Light Power and Storage company for the whole of the dynamo machinery and arc lamps for the installation.

The Fort Wayne Jenney Electric Light company now have 2,100 lights in operation in Harlem, N. Y., from alternating current dynamos. A 600 light machine was put in operation seven months ago, and since its starting has not burned out an armature nor met with an accident of any kind. Two 800 light machines were started on the 15th and, notwithstanding they have been running fourteen hours a day, have been operating without a hitch of any kind. The ratio of conversion is 20 to 1, 1,000 volts in the primary and 50 volts in the secondary. The two 800 light dynamos are run in multiple arc.

The Menasha (Wis.) Electric Light company started Tuesday, March 20th, with 25 arc lights on the streets of the city on a five years' contract.

THE TELEPHONE.

The following press dispatch dated March 21st was sent from St. Joseph, Mo.: "There promises to be an interesting suit between the Bell Telephone company and either the Union Street Railway company or the city of St. Joseph in a few days. The telephone company claims that its Savannah wire has been rendered almost useless by the stronger electrical current required for the operation of the electric street railroad, and that when the line is extended to the main part of the city the entire system will be greatly damaged."

The annual meeting of the stockholders of the American Bell Telephone company was held in Boston, Mass., on the 27th. The treasurer's statement showed that earnings from all sources were $3,453,027.70 and expenses, $1,242,430.89, leaving the net earnings $2,210,596.81, to which adding miscellaneous credits of $27,011.31 makes a grand total of $2,237,608.12. The dividends paid during the year, 16 per cent. on the capital stock, amounted to $1,568,336. The total surplus Dec. 31, 1887, was $2,028,035.92.

The report of the directors showed that the business of the company for the year 1887 was on the whole satisfactory; that the receipts for royalties exhibited a reasonable increase, and that the licensed companies, with but few exceptions, have improved and extended their plants. The number of exchanges is 743. Total miles of wire, 145,732, of which 8,009 are under ground. The total number of subscribers was 158,732. The number of instruments in the hands of licensees under rentals is 380,277, an increased 26,759 over last year. The number of exchange connections daily in the United States is estimated at 1,011,517. The average number of calls per subscriber showed an increase of 9 per cent.

Concerning the supreme court decision the report says: "All the cases on all points are determined in favor of the company. The scope of the patent for which we have contended was sustained by the court. Justice Bradley, in behalf of himself and Justices Field and Harlan, expressed an oral dissent on the question of fact concerning Drawbaugh's priority of invention. Otherwise the opinion expressed the unanimous opinion of all the members of it."

It appears that bills for the regulation of telephone rates have again been introduced, but the result of the Indiana legislation has been so unsatisfactory to subscribers that the directors hope that no such measures will be adopted. The long distance service, which has already been extended from New York to Albany and to Boston, a total of 550 miles of pole lines and 10,000 miles of wire, is to be still further increased by the construction of lines westward from Albany toward Buffalo and from Chicago to Milwaukee at an estimated cost of $1,000,000.

THE TELEGRAPH.

A. P. Swineford, governor of Alaska, has been urging the officials of the Canadian Pacific Telegraph company to extend their line to Alaska.

A queer mid-air spectacle was witnessed at noon yesterday by a whole boarding-house full of people and throngs of excited school children.

A mouse was walking one of the high wires of Pacific Postal Telegraph company opposite the Rossmore House on Stockton street. When he had got thirty feet away from the telegraph pole the mouse grew very timid and scarcely advanced at all. At length he grew bolder, and finally made the perilous distance of over three hundred feet to the next pole. The wire must have been at least twenty feet from the ground, and how the mouse got so high in the air on the wire and was enabled to walk at all was a cause of much wonder to everybody. A child at length explained the mystery of the mouse's queer journey by narrating how a black-and-tan dog had pursued it, making it take to the pole. When the mouse had completed its dangerous mid-air trip, he climbed down the pole and stepped on the hand of a looker-on, who carried him away in triumph.—*San Francisco Examiner.*

NEW ENTERPRISES.

A new theater to cost $115,000 is to be built in Rochester, N. Y. About $30,000 of this amount will be paid for the real estate and the remainder invested in the building proper. It is intended to build a first-class modern theater. Warner & Brockett, architects of that city, will have charge of the exterior and Leon Lempert, also of Rochester, will have the interior arrangements in charge.

Miscellaneous Notes.

The Knight Electric Gate company of Alexandria, Va., has been incorporated with a capital of $1,500,000.

Wirt B. Harvey of Memphis, Tenn., has invented a secondary electric clock, which is designed to operate in a circuit where a regulator or master clock causes the circuit to be closed for a short time during each minute; the invention being designed to simplify the action and increase the efficiency and certainty of operating, connecting and synchronizing the hands of the secondary clock.

The city of Rushville, Ind., has decided to put in a fire alarm system.

The city council of Mobile, Ala., has voted to secure a complete fire alarm system.

A force of men is now employed breaking up the three large cable tanks of the Great Eastern, in which were once stored the cables which first spanned the Atlantic.

When an electric current passes from a solution of certain metallic salts with the atmosphere of gas or vapor immediately above such solution, an electrolytic separation of the metal takes place at the surface of the liquid. M. J. Gubkin has recently described an apparatus by means of which this is made evident, and in which a partial vacuum may be produced above the liquid. Silver and platinum are found to separate out in films which float on the surface; while zinc, in contact with air, oxidizes as it separates; the white flakes of zinc oxide gradually falling to the bottom of the liquid.

The Stock Quotation company has sued the Chicago board of trade for $15,000 for withholding market prices. The board of trade's defense is that the plaintiff company furnished quotations to the bucket shops. This charge the quotation company denies.

The municipal council of Sofia, Bulgaria, is considering the question of lighting the city by electricity, and offers a prize of 5,000 francs for the best scheme of illumination, either by gas or electricity.

Personal.

A. H. Roehm, of the Detroit Electrical works paid a flying visit to Chicago last week.

Business Mention.

The Kansas City Electric Light company, E. R. Weeks, general manager, seem to be well equipped to meet any demands in the way of light and power, judging from a recent illustrated circular issued by them, showing Edison, Thomson-Houston and Westinghouse dynamos and Baxter and Sprague motors.

The O'Keenan Electric manufacturing company has filed its certificate of incorporation at Albany, N. Y. It will carry on its business in Brooklyn. The incorporators are William M. Grinnell, Edward H. Landon and Charles L. Perry.

The Railway Supply company finds its quarters at 211 and 213 Randolph street, Chicago, daily becoming too cramped to accommodate its business. On May 1st, the business will be removed to the large four story building 54 and 56 Franklin street. The company has been organized four years. During that time a prosperous business in telephone, telegraph and fire alarm supplies has been established.

The Garlock Packing company, of Palmyra, N. Y., has recently established houses at Gadsden, Ala., and Hamilton, Ont. The orders received by them in the past two months have been double the amount received during any previous two months, and there is a fine prospect for a steady increase.

The Heisler Electric Light company, of St. Louis, Mo., within the last month have completed the following central station plants, including street and commercial lighting on their alternating direct current single wire system, using low resistance lamps: A 300 light plant at Napal, Cal.; one of 600 lights at Salem, Ore.; one of 300 lights at Albany, Ore.; and one of 400 lights at Saugerties, N. Y. The same company have under construction to be completed this month the following: A plant of 200 lights at Wabash, Ind., for street lighting exclusively; one of 600 lights at Red Bank, N. J.; one of 400 lights at Orange, N. J.; one of 400 lights at Ocean Grove, N. J.; one of 600 lights at Fayetteville, Ark.

F. E. Degenhardt, Chicago, manager of the Standard Underground Cable company of Pittsburgh, Pa., has recently taken orders for cables: Central Union Telephone Co. 2,700 feet of 100 wire, No. 22 B & S. gauge, for Quincy, Ill; Accumulator Co. of Detroit, Mich., 2,500 feet of No. 3 B & S. gauge, for incandescent work; Missouri and Kansas Telephone Co. for St. Joseph, Mo., 8,000 feet 100 wire No. 22 B & S. gauge.

Chas. A. Schieren & Co, of New York, report recent sales of leather link belting to the following concerns for use on dynamos: Portsmouth Electric Light company, Portsmouth, N. H.; New York Electric Construction company, 122nd street, between 2nd and 3rd avenues, New York; United States Electric Light company, 59 Liberty street, New York.

The United States Electric Lighting company, C. C. Warren, manager of the western department, have just issued a handsome catalogue containing testimonials from western patrons only to the worth of the electric light apparatus furnished by the company. The cover is original, unique and highly artistic. The front page of the cover happily compares the light of "ye olden time" with that of the present day, while the back page illustrates the seven ages of illumination: The ancient, the mediæval, the barbarian, 1776, 1871, "Mrs. O'Leary and her cow," and the "incomparable 1888." The catalogue needs to be seen to be appreciated. It bears the new address of the western office: The Rookery, La Salle and Adams streets, Chicago.

The Electrical Patents.

Issued March 20, '88.

379,567. Application of Electricity to Car Lighting. Camille A. Faure, New York, N. Y.

Claims 2 and 7 are given, as follows: "The combination of a car or vehicle, a dynamo electric machine having its armature mechanically connected with an axle of said vehicle, a secondary battery carried by said vehicle and electrically connected with said dynamo, and means for varying the strength of the field magnetism of said dynamo whereby the dynamo may be used to charge the battery.

"The combination of a dynamo electric machine, a secondary battery, an electric circuit uniting the dynamo and battery, a circuit breaker in the main circuit, and a polarized electro magnet having two coils, one of which is located in the main circuit and the other in a derived circuit, said coils co-operating to control the movements of said circuit breaker."

379,572. Electric Storage Battery. Charles D. P. Gibson, New York, N. Y.

379,598. Plug for Making Electrical Connections. Gustav Otto, Jersey City, N. J.

379,689. Dynamo Electric Machine. Marcel Deprez, Paris, France.

The field of force is furnished by a series of independent electro magnets placed in inductive relation to two separate armatures mounted upon the same shaft, and the arrangement is such that one pole of each electro magnet acts upon one armature and the other pole upon the other armature.

The armature cores are laminated, and are, besides, built up of segmental sections so constructed that they may be put together or taken apart with ease.

379,758. Electric Annunciator. Barnet N. Botts, Paso Robles, Cal.

379,766. Tele-Thermometer. Fernando J. Dibble, New York, N. Y.

379,770. Incandescent Electric Lamp. Thomas A. Edison, Menlo Park, N. J. Filed December 9, 1881.

The object in view is to produce a lamp which shall have a high resistance with a small radiating surface. All connections to the carbon are preferably made by electro plating.

The excessive length of coiled carbon gives proper amount of resistance, while the manner in which the carbons are coiled decreases the radiating surface. The claims are given:

"1. In an incandescing electric lamp, the combination of two carbons, placed one within the other, for reducing their effective radiating surface and increasing the electrical resistance.

"2. In an incandescing electric lamp, the combination of two or more spiral carbon conductors, connected in series, the coils of one covering and partially hiding those of the others."

379,771. Regulator for Dynamo Electric Machines. Thomas A. Edison, Menlo Park, N. J.

The object of the invention is to produce a method and means for deriving from a dynamo electric machine two or more independent circuits in which there will be a different electromotive force or pressure, such circuits being adapted for independent regulation. Claim 3 is as follows:

"The combination, with a main circuit having a current of high tension, of two or more secondary batteries arranged in series in such main circuit and shunts around such secondary batteries containing translating devices, such as electric lamps or motors, whereby a division of the current in the main circuit is secured."

379,772. Sytem of Electrical Distribution. Thomas A. Edison, Menlo Park, N. J.

The main object is accomplished by throwing into the main circuit, at a number of points, a counter electromotive force, which causes between certain points a definite drop in the tension of the main circuit. From these points are run pairs of conductors, and the translating devices—such as lamps or motors—are located in multiple arc circuits from these auxiliary conductors. Each pair of auxiliary conductors, with its translating devices, forms a shunt circuit from the main circuit.

379,792. Electric Arc Lamp. Edward R. Knowles, Brooklyn, N. Y.

The invention consists in the combination of a non-combustible insulating ball with the upper carbon rod and holder and a non-combustible insulating plate with the lower carbon holder and lamp frame.

379,802. Electro Mechanical Movement. James F. McLaughlin, Philadelphia, Pa.

379,815. Apparatus for Increasing the Traction of Vehicles and Motors. Elias E. Ries, Baltimore, Md.

379,816. Electro-Magnetic Traction Increasing Apparatus. Elias E. Ries and Albert H. Henderson, Baltimore, Md.

379,820. New Mecuric Salt for Battery Fluids. Alexander Schansschief, Gipsy Hill, County of Surrey.

379,822 Electric Heater. Carl Seiler, Philadelphia, Pa.

Claims 2 and 5 follows:—"2. An electric heater consisting of a radiating surface of fire-proof insulating material, having conical projections around and in contact with which heating conductors are placed, and which are capable of being heated by the coils."

"5. The combination of the electric heater, line-conductors, and a short circuit around the electric heater, with resistances and a commutator switch in the said short circuit."

379,832. Electrical Stop Motion for Knitting Machines. Wait Talcott, 2d, Rockford, Ill.

379,842. Socket and Key for Incandescent Lamps. Gilbert Wilkes, U. S. Navy.

Claim 5 follows:—"An incandescing electric lamp having leading in wires whose extensions are of spring metal, bent and corrugated as described, and the extremities of which are insulated, in combination with a suitable socket whereby the lamp can be readily removed or placed in position."

379,904. Elevated Railroad and Conduit for Electric Wires, etc. Albert O. Oehrle, Philadelphia, Pa.

379,909. Traction Increasing System for Electric Railways. Elias E. Ries, Baltimore, Md.

The invention is based upon the fact that a strong adhesive effect between metallic conductors in contact with each other is produced when an electric current is passed from one to the other.

The object of the invention is to utilize the phenomenon of increased friction produced by the passage of an electric current between the wheels of a motor car and the rails upon which it travels for increasing the traction of the moving vehicle at the will of the operator or engineer, so as to have it entirely under control and adjustable according to the demands of the system from moment to moment.

379,911. Galvanic Battery. Alexander Schanschieff, Gipsy Hill, County of Surrey.

We give the claim:—"The combination, with a galvanic battery cell and electrodes, of an exciting fluid consisting of a compound of yellow basic sulphate of mercury, and bi-sulphate of mercury having substantially the formula specified, dissolved in water."

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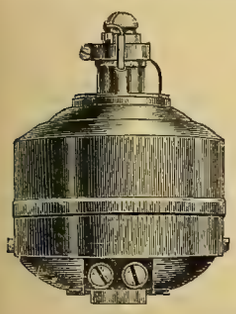

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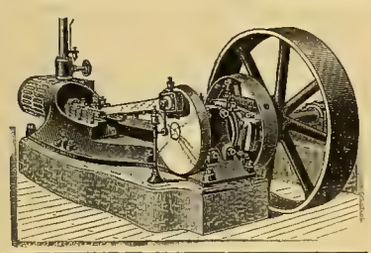

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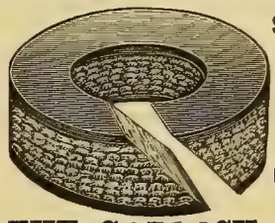

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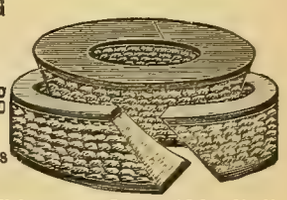

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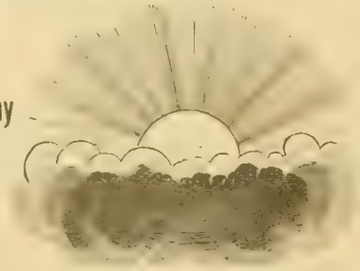

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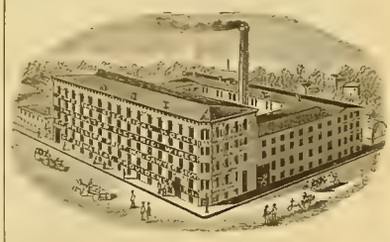

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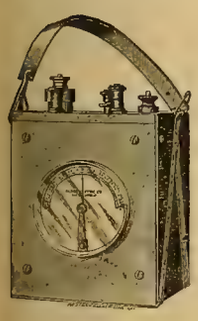

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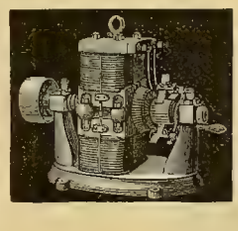

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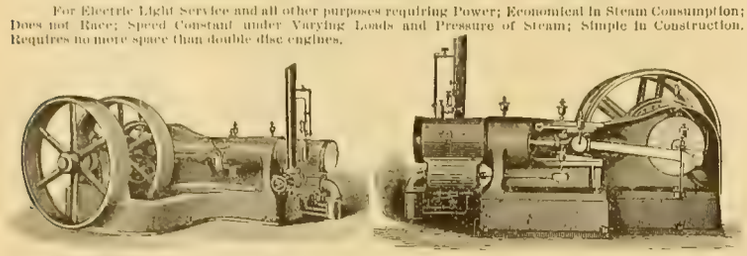

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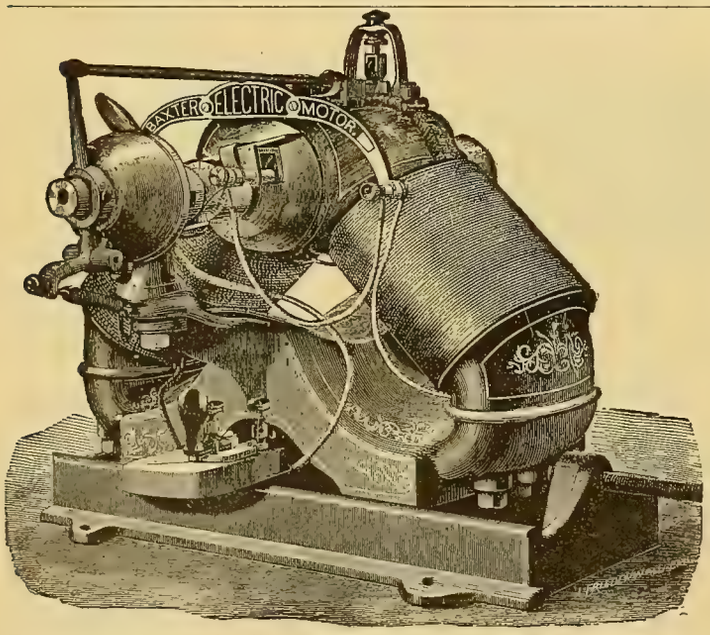

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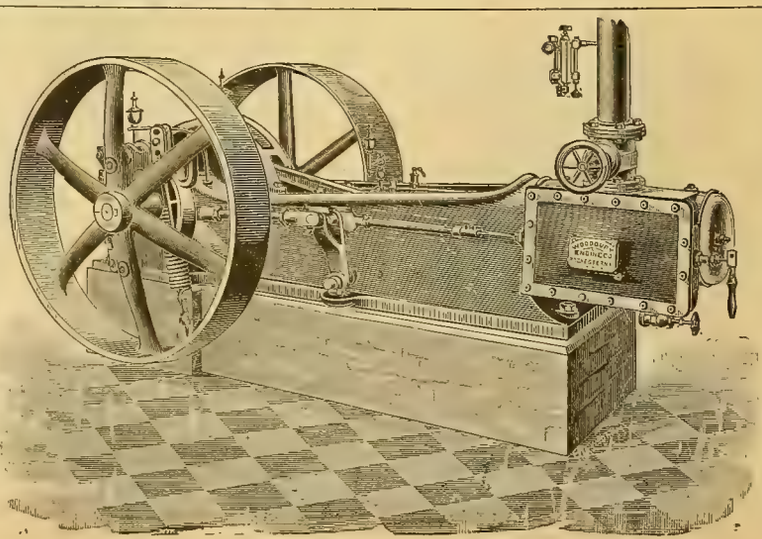

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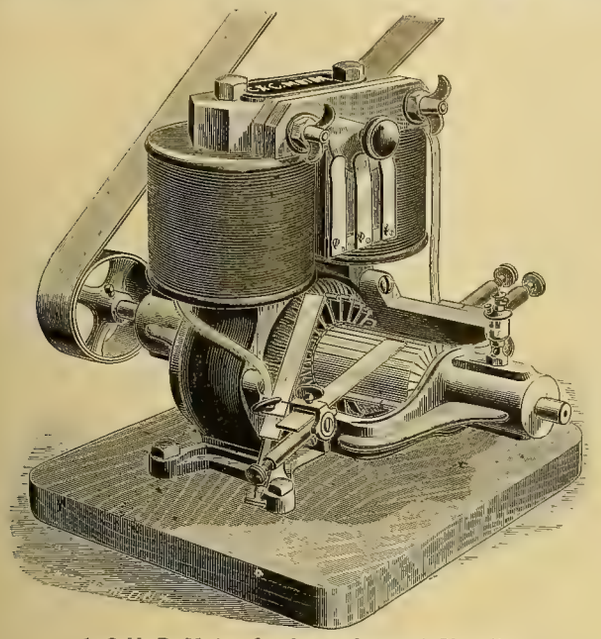

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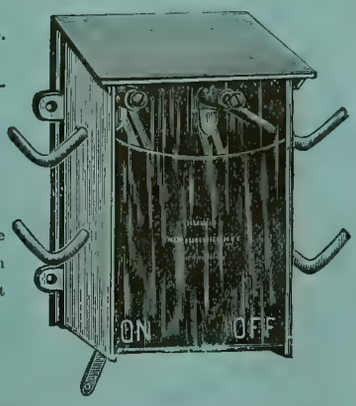

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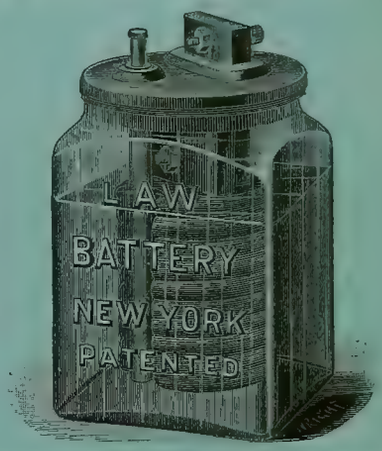

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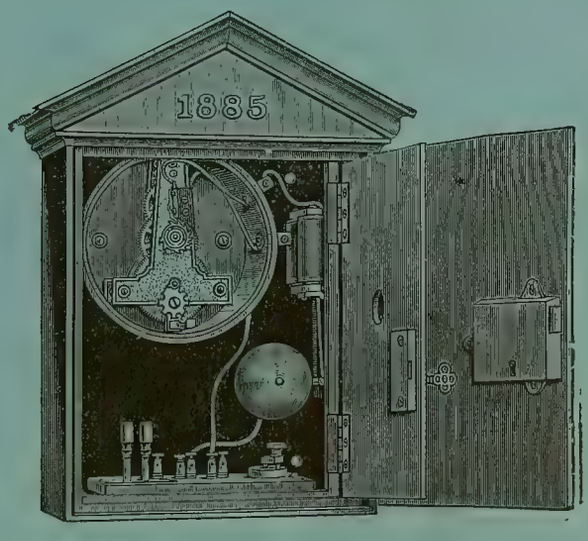

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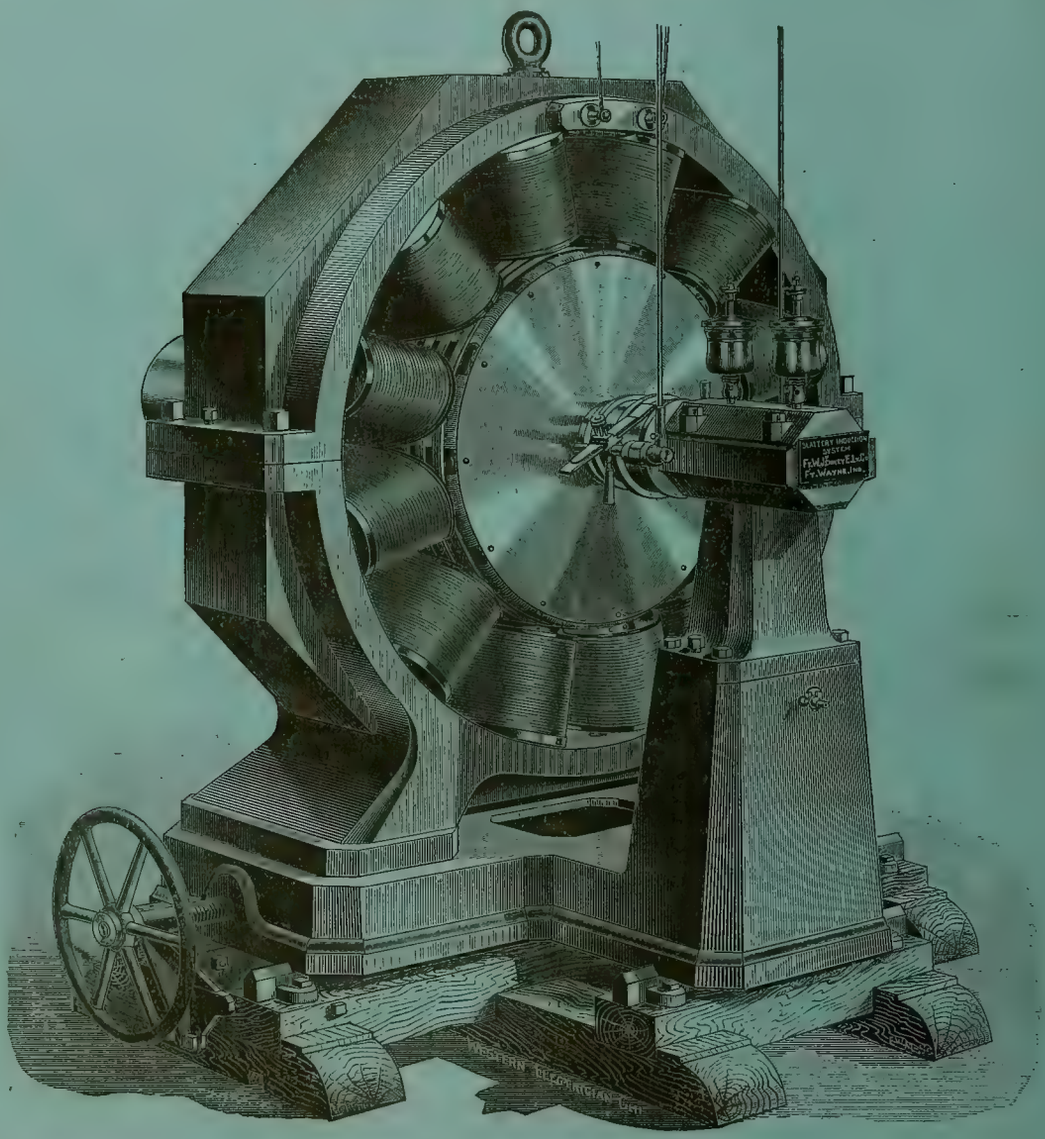

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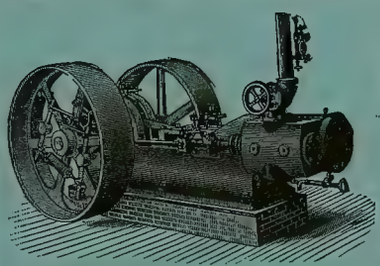

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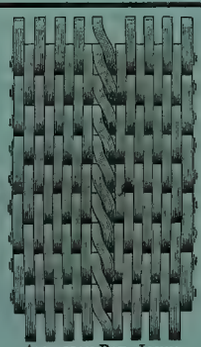

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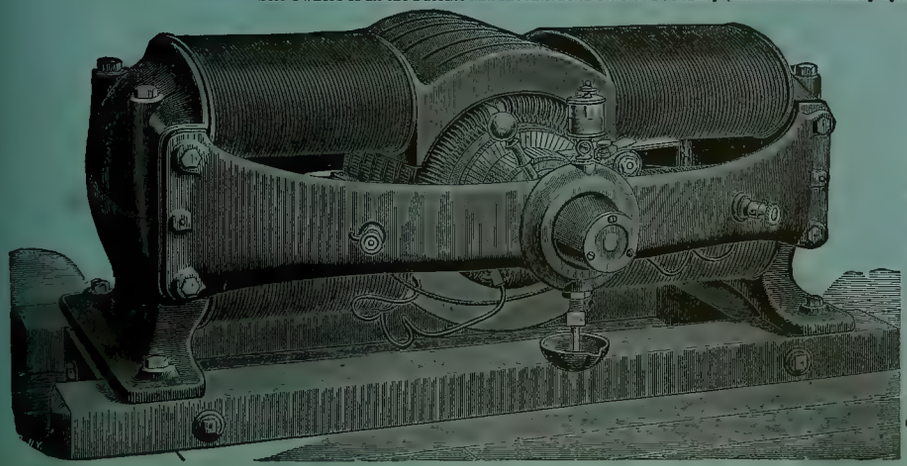

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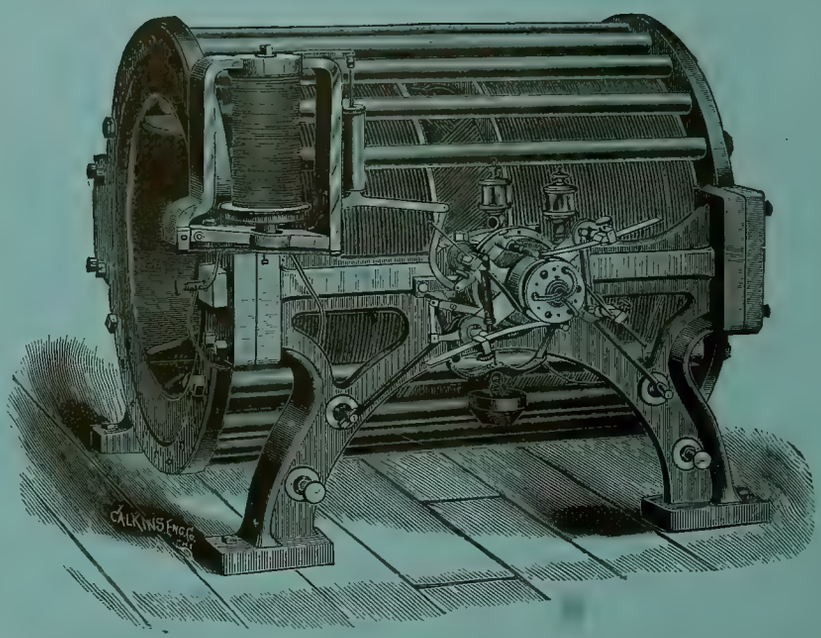

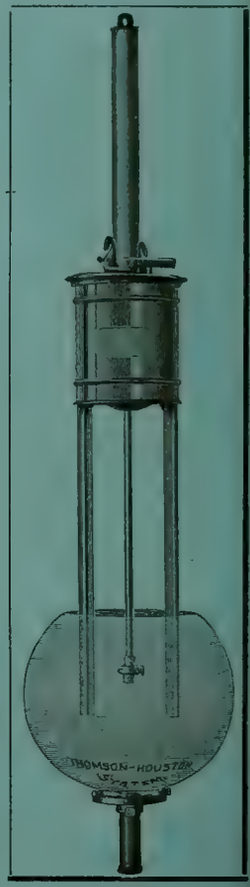

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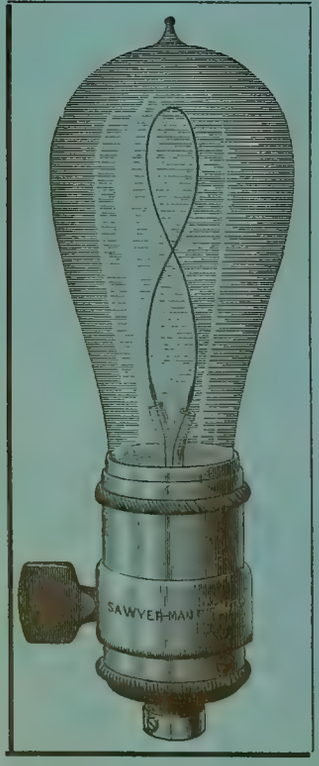

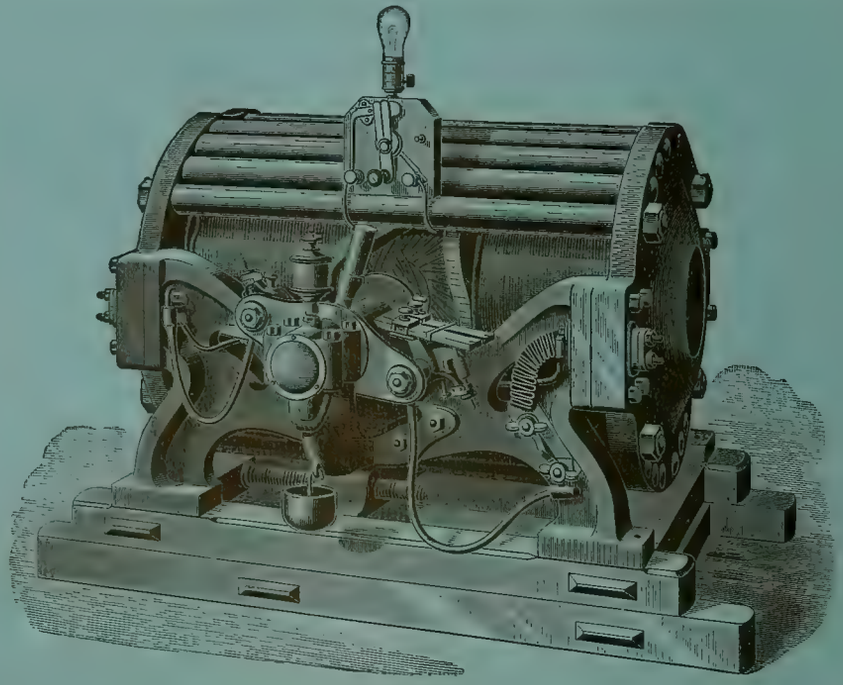

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G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

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Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

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348 Edison 16 " " 54 " "

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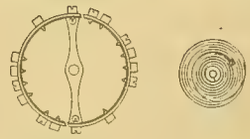

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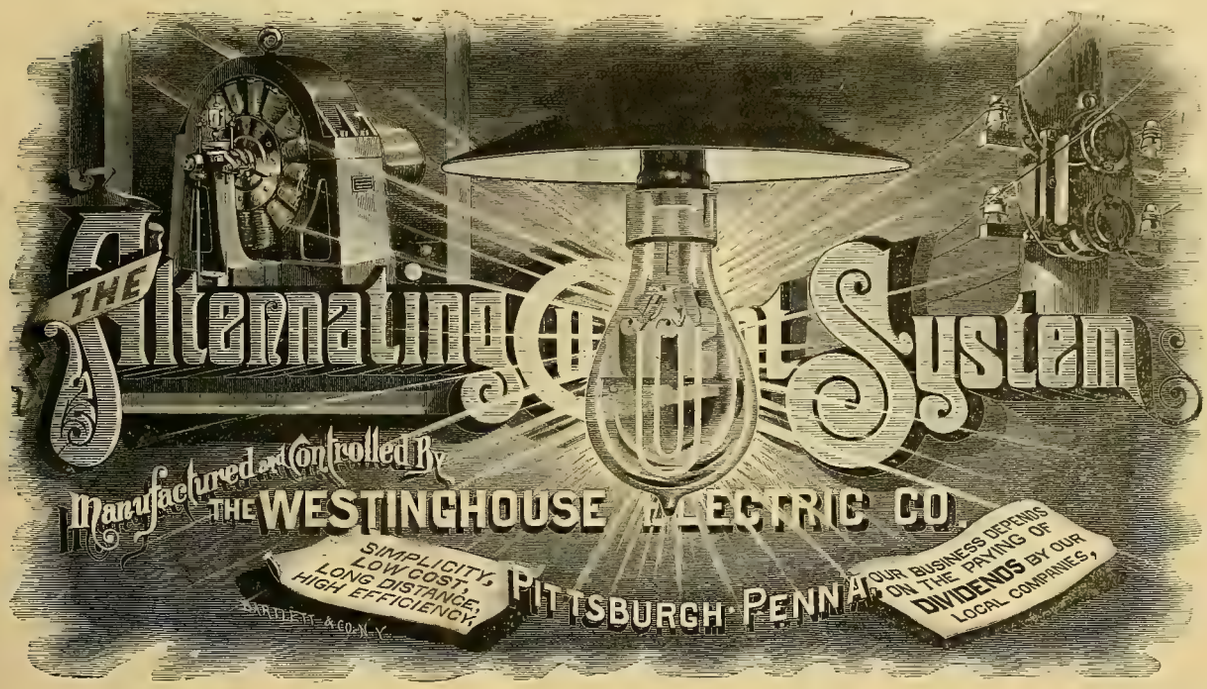

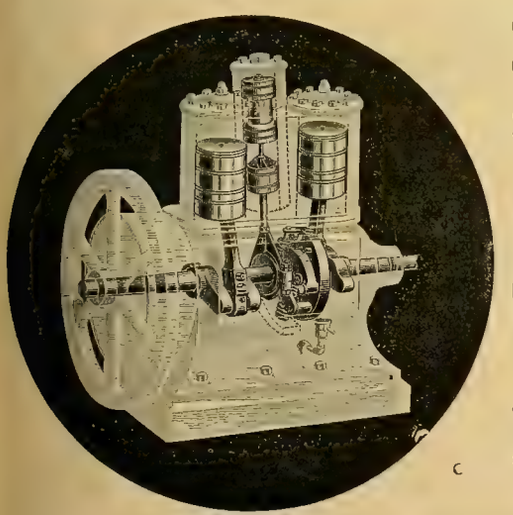

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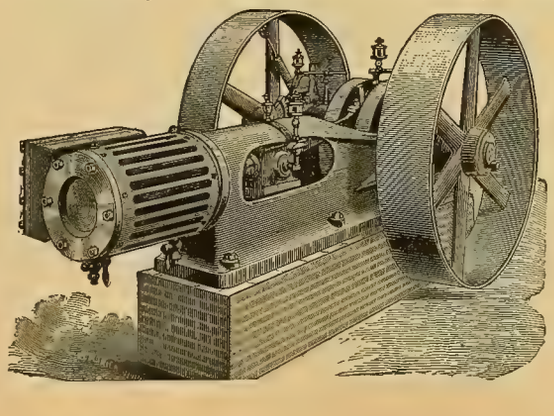

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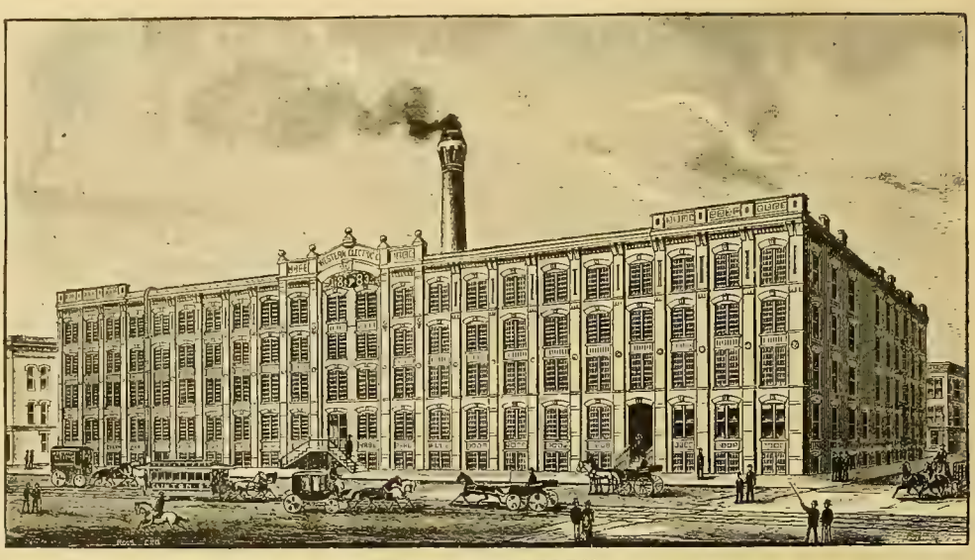

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Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, APRIL 7, 1888. No. 14.

A New Pattern of Reflecting Galvanometer, with Lamp and Scale.[1]

By G. L. Addenbrooke.

The instruments which I am about to describe are the outcome of improvements and modifications which have suggested themselves from time to time as the result of a good deal of experience in electrical testing for telephonic, electric lighting, and general experimental purposes. As usually constructed, the reflecting galvanometer is essentially a laboratory instrument, demanding care and skill for its management besides being costly. Perhaps the greatest objections to it are, however, the difficulty of moving it and setting it up, and the time usually taken to put it right when it gets out of order. When, however, it is in good working order there is so much satisfaction in working with it that one returns with reluctance to the use of other instruments.

In the instrument before you it has been my aim, while preserving to the full the sensitiveness usually obtained in good laboratory instruments, to simplify and alter the construction, and thus fit it better for every day needs, without at the same time diminishing its efficiency for the work with which it is now more particularly associated.

It is constructed as follows: Fig. 1 shows the instrument complete. The base is circular and 5 inches in diameter. The case is of brass, its top being 6 inches above the base. The adjusting magnet, which is removed for carriage, rises 8 inches further. The instrument is thus very

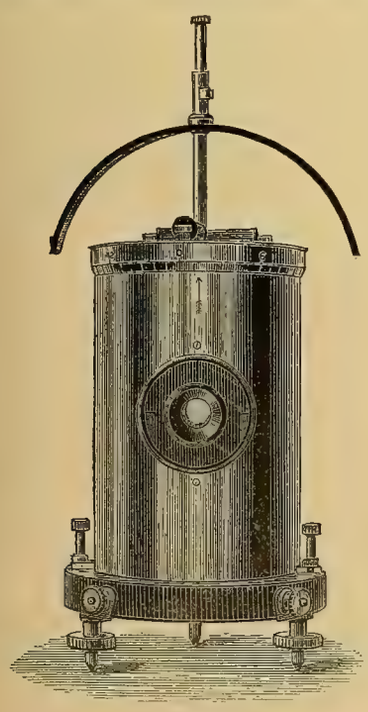

Fig. 1.

small and compact. The adjusting magnet works up and down on its rod, a slot in the rod preventing lateral movement. Lateral movement is provided for by rotating the top of the case, which is marked with degrees so that the magnet can always be brought back to the same position again directly if it is necessary to move it. The spirit level or levels for setting the instrument are on the top of this lid. The case itself is provided with two L pieces at the bottom, engaging in two screws with milled heads on the base. By giving them half a turn, and rotating the case slightly, it can be lifted off.

Fig. 2 shows the appearance of the instrument when the case is taken off. Rising from the base are two parallel uprights of ebonite; four brass rods pass up through these, holding them in their places on the base, and forming the means of connecting the terminals with the wire on the bobbins. Further, there are four small thumb screws, which will be seen near the top of

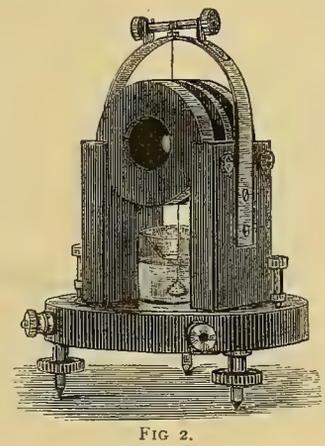

Fig. 2.

the ebonite uprights, two on each. These screws pass through the brass rods I have mentioned, and into the outside cheeks of the bobbins.

The shape of the bobbins will readily be seen in the figure. The outside cheeks are left much thicker than the inside, and all the cheeks project about ⅛ inch beyond the coils of wire. The lower halves of these projecting cheeks are cut away at the sides, as can be seen in the figure, leaving the upper portions projecting, so that the coils rest on the projecting portions on the ebonite uprights, and slide exactly into their places. The cut away portions of the thick ends of the bobbins are faced with brass plates, to which the ends of the coils are soldered. The thumb-screws above mentioned screwing into the brass plates complete the connections, and hold the bobbins firmly in their places.

Both bobbins can thus be taken out in a moment without disturbing the needle; there are no awkward connections to make or to get out of order, and if desirable several sets of bobbins can be made, wound with different lengths and sizes of wire to fit the same instrument, which can be interchanged without trouble at any time.

Now we come to the needle. The suspension is of quite a different type to that usually employed. A brass hoop will be observed passing over the center of the bobbins and screwed at either end to the ebonite uprights. The whole galvanometer is put in the lathe and a very small hole bored centrally through this brass hoop. A V shaped slot is then cut in the brass hoop from the front towards the back of the instrument, the point of the V groove ending in the small central hole. About half an inch on each side of the hole two brass uprights are fixed; they are forked at the top, and hold by friction a little ebonite rod with milled heads at each end.

One end of a silk fiber is attached anywhere on this rod, the other end is attached to the needle. The fiber may be a yard long if desired. The ebonite rod is then turned, winding the fiber round it until it, the fiber, is about the right length, and then the ebonite rod is slipped into its place.

The fiber then, if it is wound the right way round the rod, at once automatically centers itself and by rotating the rod the needle can be set exactly. By this means a long suspension is secured, and, if it is desired, several rods and needles can be kept for different purposes — say, one with damper for general use, and a finely balanced astatic one for delicate testing, and a ballistic needle for condenser work. When the instrument has to be carried about a great deal, spare needles, ready suspended, can be kept and be put in in a minute at any time, should an accident happen. If the suspension of a needle does break, it is often at a critical moment when time is important. To replace it is, as usually suspended, as a rule a long and tedious job. Much valuable time may therefore be sometimes saved by the use of a suspension of this character. It will readily be seen that attaching a new fiber is a very simple and short operation compared with that necessary with the ordinary type of instrument. The needle itself consists of a stiff aluminum wire, carrying the magnets and mirror.

For all ordinary testing work I prefer to bend the lower end of the aluminum wire round into a loop and flatten it out. This makes an excellent damper; it is sufficient to prevent long swinging and annoying vibrations, without rendering the instrument dead and sluggish. This damper works in a little glass jar, fixed in the base of the instrument. The jar has its edges turned over to prevent the liquid being spilled when carried about.

It is, of course, easy to add a second pair of coils on the same principle as the two in the in-

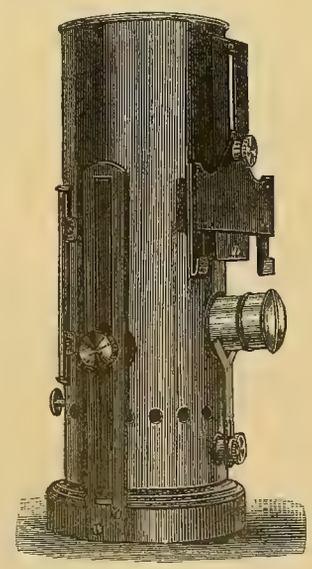

Fig. 3.

strument before you, should it be desired, but a constant 1° deflection with 1 volt through 1,000 megohms can easily be got with a single pair of coils, which is more than sufficient for most purposes.

In using reflecting galvanometers a lamp and scale are required. All who have had experience in working with such instruments, know that there is often as much trouble with the lamp and scale as with the galvanometer.

In the lamp and scale I have here, Fig. 3, I have tried while securing the maximum efficiency to reduce the whole within as small a compass as possible. The lamp itself consists of a copper tube

[1] Read before the Physical Society.—*London Electrician*, March 16th.

about 12 inches long, and 4¼ inches in diameter. The bottom of the tube forms the reservoir, the top portion acting as a screen. This tube is supported by guides at the sides attached to a metal base, which permits of the lamp being moved up and down through a total range of 6 inches.

In order to fill the lamp easily, a funnel is provided in the top of the reservoir, with a tube attached, which reaches nearly to the bottom of the reservoir. In this way the lamp can be quickly and cleanly filled, and there is no need of a screw stopper to keep the paraffine from spilling or evaporating.

Most essential points in the construction of the lamp are that the longer axis of the flame and the axis of the lens or slot should coincide, and, further, that the intensest part of the flame should be opposite the center of the lens. In this lamp, by prolonging the rod carrying the milled head for adjusting the wick, and causing it to fall in a slot in the tube just below the door at the back, the longer axis of the flame is always kept in the proper place. Again, the height of the burner is carefully adjusted to be right when the lens is in a horizontal position. Further, to allow the lamp to be used in various positions, and with different instruments, the lens tube is made adjustable through a considerable angle, its axis of rotation being the center of the flame. In this way a beam of light can be thrown upwards or downwards as well as in the horizontal direction. This is in working often a matter of great convenience.

For use with the lamp I have arranged a specially portable scale and shade. The scale itself consists of ½ a meter divided into millimetres. It is mounted on a thin board, as usual; this board is attached to a shade of the same length by long hinges. The whole is then cut through the middle, and a hinge fixed on the back of the shade. By this means the whole folds into half its length. Guides are fixed on the back of the scale, which engage in hooks fixed to a cross-piece on the front of the lamp, so that the scale slides easily backwards or forwards, and means are provided for raising or lowering the scale by itself, which is often convenient.

For carrying about or putting on one side, a box is arranged to take both galvanometer and lamp, with room for shunts and other accessories.

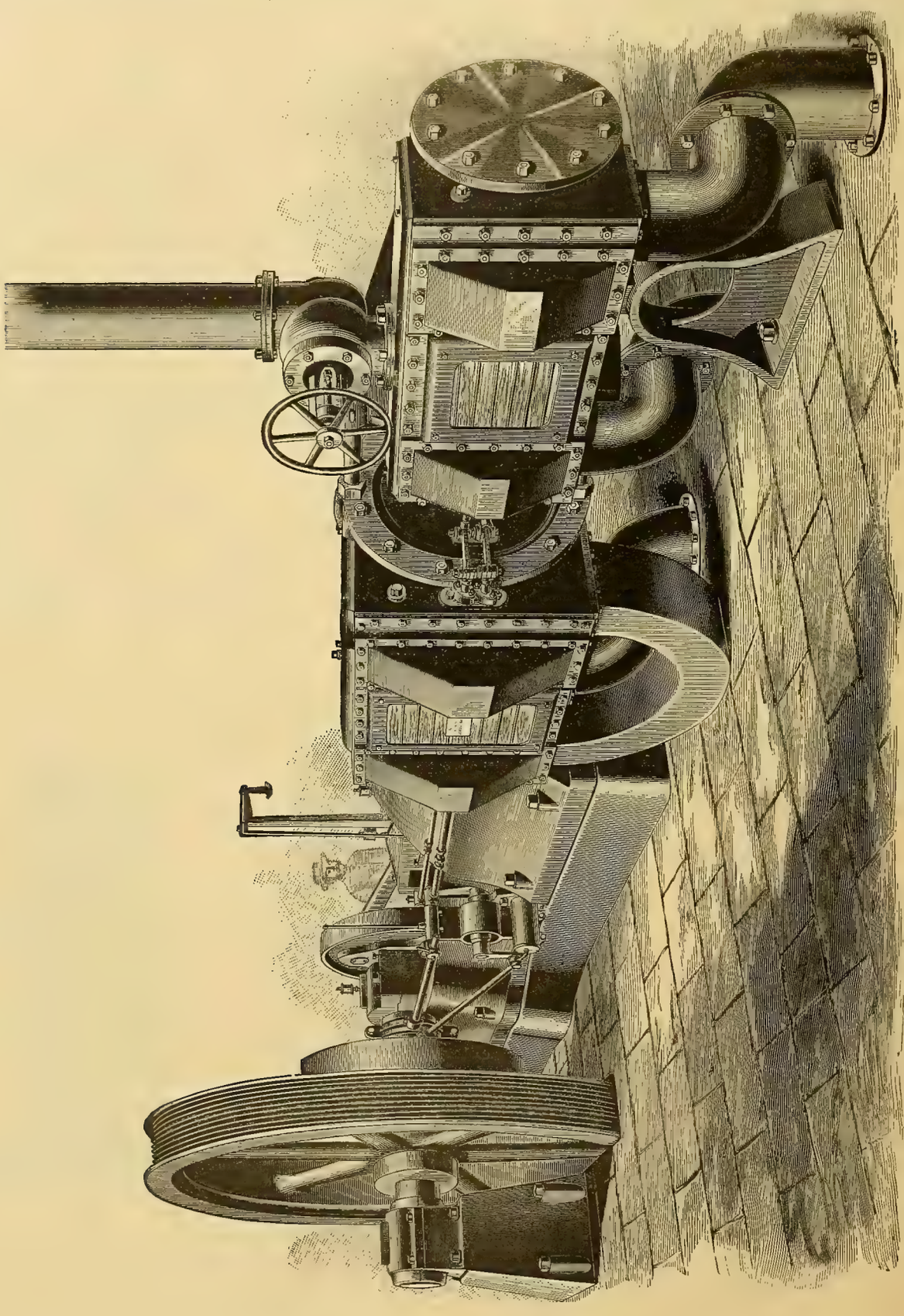

Fig. 1. Williams' Compound Condensing Engine.

Williams' Compound Condensing Engine.

The illustration, Fig. 1, shown on the opposite page, represents what is believed to be the first engine of its class in America. It is located at the central station of the Chicago ArcLight and Power company, Market street, Chicago, and is driving the dynamos for from 400 to 550 arc lights.

The engine was designed by Ed. F. Williams and built by William Tod & Co., Youngstown, Ohio, under Mr. Williams' supervision.

It is classed as high speed automatic cut-off tandem compound condensing, and is rated 500 horse power. The cylinders are: High pressure 19½ diameter, low pressure 35″ diameter. The stroke for both pistons is 35″ and the rate of rotation of crank shaft 140 per minute. The piston speed is consequently 794 feet per minute and 23 horse power will be accomplished by one pound mean effective pressure on the low pressure piston; 500 horse power will require about 22 pounds m. e. p. on the l. p. piston. The displacement ratio of piston is 3.25 to 1, and the receiver space equals about four times the displacement of the h. p. piston. The boiler pressure varies from 80 to 100 lb. gauge.

There is but one cut-off valve, and that is in the high pressure steam chest. The accompanying cut, Fig. 2, shows a general plan of valves, and intermediate valve gear. The latter is composed of two horizontal levers to which are attached, at one end the valve stems from the l. p. chest and at the other pivoted links. At intermediate points about ¼ distance from the moving end are attached the driving stems of the h. p. valves. In this manner the clumsy off-set so generally used in marine practice is avoided, and a light graceful mechanism introduced in its stead.

The valves for both cylinders are balanced by Mr. Williams' system, using what he terms "relieved pressure plates," at their backs allowing a double opening both for steam and exhaust.

The movements of the engine, notwithstanding the high speed at which it is running, are remarkably free from jar. This very gratifying result has been accomplished by a very skilful distribution of steam and inertia forces. We hope to hear more from Mr. Williams on this subject, and are promised diagrams for publication.

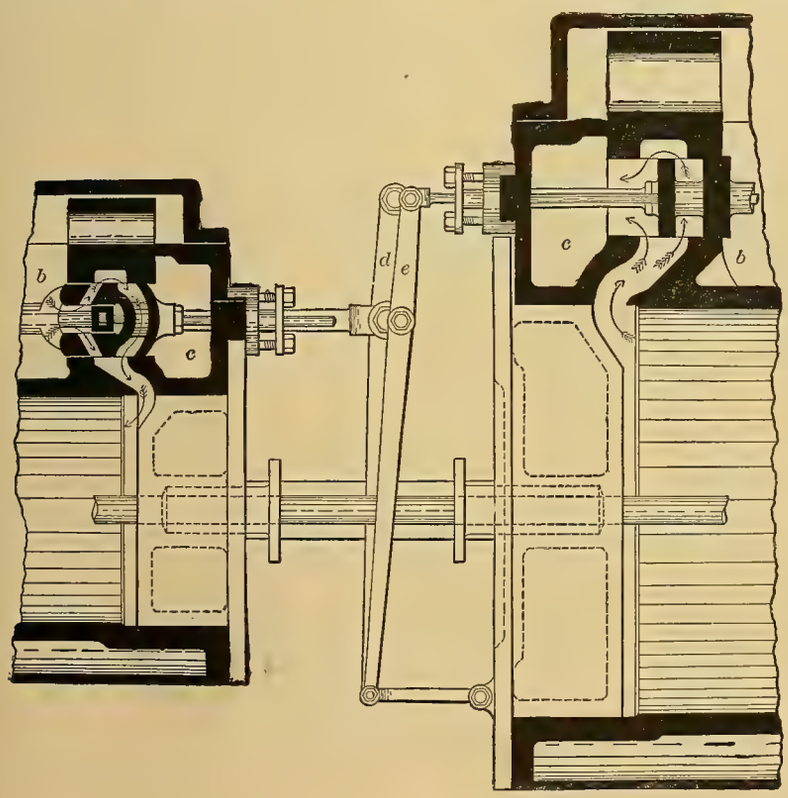

Fig. 2. Williams' Compound Condensing Engine.

No steam jackets are used except in the cylinder heads. The cylinders are lagged with wood, and the receiver and intermediate steam connections are protected from loss by external radiation, having non-conducting coverings. Nearly one-half of each cylinder is surrounded by its steam chest.

The low pressure cylinder is bolted directly on the end of the frame which is the Porter type, having a hood equal in diameter to the outside measure of the low pressure cylinder lagging.

Mr. Williams believes a frame thus proportioned to the lower pressure cylinder is absolutely essential to the tandem high speed compound engine. In order to get the strength of bed necessary to hold the cylinders firmly, the high pressure cylinder is secured in position directly back of the low pressure cylinder, by stout stays four in number, two of which are screwed into the low pressure cylinder and keyed into the high pressure cylinder. The latter cylinder rests also on a base piece, having freedom to slide backward and forward slightly to allow for expansion and contraction. The pistons are long and light and have "snap" rings sprung into grooves near the ends. The governor is placed upon the crank shaft and operates the cut-off eccentric by a direct connection, rotating it about an eccentric sleeve, backward and forward as the cut-off requires to be later or earlier in the stroke.

Some of the measurements and weights are as follows:

Diam. H. P. Cylinder	19½ in.
" L. P. "	35 in.
" Crank pin	8½ in.
" Crank shaft (wrought)	15 in.
" Crank disk	60 in.
" L. P. piston rod	4¼ in.
" H. P. piston rod	2¾ in.
" Main bearing	14½ in.
" Fly wheel	15 ft.
Length of stroke	34 in.
" of connecting rod	102 in.
" of crankhead	28 in.

The entire engine weighs about 95,000 lbs.

The Schutte condenser is used, requiring no air pump and no steam except exhaust. The power is transmitted by ropes traveling at the rate of 6,580 feet per minute. Only 18 inches are required upon the driving wheel face, grooved for 10, one inch ropes. If a double leather belt were used, about 50 inches width of wheel face would be required.

A second engine of the same size has just been completed and is situated in the same engine room, under the general plans of J. A Dyblie, chief engineer for Chicago Arc Light & Power company. This makes 1,000 horse power for this station and more engines are yet to be erected. We are informed that Mr. Williams has associated his engine interests with Fairbanks, Morse & Co.

New Gas Attachment.

The wide and constantly increasing use of incandescent electric lamps in offices, stores and dwellings has brought out many devices by which the socket or lamp holder may be attached to existing gas fixtures. The accompanying cuts, Figs. 1 and 2, represent one of the latest and most improved forms, for which advantages are claimed over all the old styles.

The device hitherto used for this purpose is made to screw under the gas burner, the end so secured being in the form of a washer, with a projecting arm, on the other end of which is a

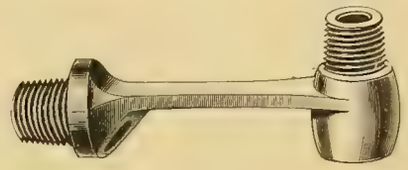

Fig. 1.

nipple screwed to fit the lamp socket. The disadvantages of this form are obvious, it is argued, in that, first, the thread on the gas fixture being tapered, and the washer taking up a portion of the larger end of same, it is often difficult to screw back the gas burner to a tight joint; secondly, frequent handling of the key on electric light socket tends to move the attachment around, and as its stability depends entirely on the pressure of the burner against the washer, it soon becomes loose, the attachment gets moved out of place, and the joint leaks, even when made quite tight at first. When in this condition, if the gas at burner is lighted, the gas escaping at the base will also ignite, and the wire conductor leading to socket is very liable to be burned off; thirdly, it is frequently the case that a shade holder is screwed under burner, and by adding the electric attachment as described, the difficulty of making a tight joint and firm hold is still further increased.

With the improved nozzle here illustrated, it is claimed, all this trouble is avoided. The gas burner is first taken off and the nozzle screwed on in its place. The gas burner is then screwed on the nozzle with the shade holder in place, if required, making a solid, permanent and gas tight job. If the attachment should not screw around into the exact position required, it can be unscrewed, and a stroke of a file on the edge left thin for the purpose will permit of its being tightened up into any desired position. Should the tip on gas fixture be too long, and so prevent the attachment from being screwed home, the defect may be easily remedied in some way. The male thread on nozzle is also made taper, so that if the gas burner goes on loose, the bottom of burner may be filed off a little and a tight joint insured.

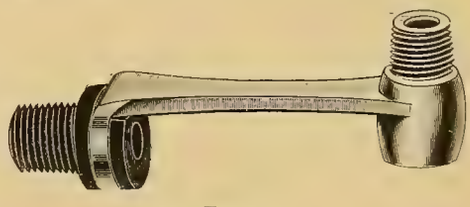

Fig. 2.

When more than one attachment is used on a fixture, all chance of short circuiting between sockets through the fixture may be stopped by using the insulating attachment shown in Fig. 2, where the black parts represent hard rubber.

This attachment has been brought out by Frank S. Marr, Bissell Block, Pittsburgh, Pa.

Chicago Electric Club.

The meeting of the Chicago Electric club Monday evening, April 2nd, was well attended. The business transacted consisted in an expression of opinion by members of the club as to the advisability of seeking new quarters. Messrs. Horne, Young, Kreidler, Badt, Pearson, Glasier, Terry, Leonard, Bliss and Buckley participated in the discussion. The chief fault found was with the café service. The culmination of the discussion was in an amendment by Mr. Buckley to the motion of Mr. Horne that opened the discussion that the matter of securing quarters

for another year be left in the hands of the board of managers who are to report to the club at the next meeting, April 16th.

The paper by Mr. Warner read before the club and the subsequent discussion will be found in another place in this issue.

Difference of Potential and Electric Current.

By Zeta.

In Professor Carhart's article on "Electromotive force and difference of potential," published in the Western Electrician of March 3rd, occurs the following statement: "A current does not always flow from the higher to the lower potential. It may even flow from the lower to the higher." In support of this, he adduces the battery circuit, and claims that while in the external circuit the current flows from higher to lower potential; in the internal, it "flows from a region of lower potential to one of higher." "The ordinary propositions," he says, "are true only when no source of e. m. f. is included in the region considered. It is possible even to have a circuit through which a current is flowing without any difference of potential in it, as stated recently by Professor Anthony." These apparently anomalous conditions he explains on the principle of the relations between potential, electromotive force and resistance.

Now, while the soundness of his views in regard to resistance will not be questioned, it is difficult to see how it is possible to maintain that an electric current can flow either from lower to higher potential, or in a circuit without difference of potential; on the contrary, the writer believes it can be successfully maintained, that in all cases the electric current flows from a region of higher to one of lower potential, just as the current of a river always flows from a higher to a lower level; and that it is impossible to have a circuit through which a current is flowing without any difference of potential between its terminals.

Take the case of the battery; the preponderance of the highest electrical opinion is in favor of the theory that electricity is generated here by chemical action; the ordinary conditions are two solids, zinc or its equivalent known as the generating electrode, and copper or its equivalent, known as the conducting electrode, partly immersed in a fluid of such a nature that when the unimmersed portions, known as the poles, are joined by an electric conductor, chemical action occurs, and a current of electricity, originating at the surface of the immersed portion of the generating electrode, flows to the immersed portion of the conducting electrode, and through its unimmersed portion, known as the positive pole, and the external conductor to the unimmersed portion of the generating electrode, known as the negative pole, completing the circuit. The generating electrode, usually zinc, wastes rapidly, the wasted portion becoming chemically incorporated with the constituents of the fluid and changing its character, while the conducting electrode, usually either copper, carbon, silver or platinum, remains practically unchanged, taking only a secondary part in the chemical action, the primary and chief seat of this action being at the surface of the immersed portion of the generating electrode, as shown by the rapid wastage; this action extending through the fluid in the direction of the conducting electrode. Now, if we accept the theory that electricity is a mode of molecular motion, and it be admitted that chemical action is another mode of molecular motion, and that the two modes of motion in the battery mutually reproduce each other, we must infer that the chief seat of chemical action is also that of electric action, and hence that the surface of the immersed zinc, or generating electrode, is the region of highest electric potential, and that this potential falls off in the direction of reduced chemical action, or towards the conducting electrode, corresponding with the known direction of the electric current.

Now, since energy can not be created, it is evident that the energy producing this molecular action is derived from the materials entering into this combination which we call the battery or cell; and that energy concentrated at one point and gradually falling off towards another point, must, to maintain the equilibrium, be derived from some adjacent region in which correspondingly opposite conditions are produced; and since at the projecting portion of the zinc, or negative pole, there is no chemical action whatever, we must infer that here, in immediate proximity to the region of highest potential, is the region of lowest potential, which rises through the external circuit round to the positive pole and through the fluid to the immersed portion of the zinc; or which is the same in reverse order, falls off from the immersed portion of the zinc, or region of highest potential, round to the unimmersed portion or region of lowest potential, corresponding throughout its entire course to the known direction of the current. This position seems entirely reasonable and in accordance with the physical facts, and free from the intricacies involved in the anomalous conditions of an electric current flowing in one part of its course from higher to lower, and in another part from lower to higher potential, as assumed in Professor Carhart's proposition.

In support of his second proposition that it is possible to have a circuit through which a current is flowing without any difference of potential in it, he adduces the example of "a circular conductor and a bar magnet thrust forward south end foremost along the axis of the circle," and claims that "when the south pole reaches the plane of the ring the lines of force radiate equally in all directions, cutting all parts of the ring in precisely the same way. An e. m. f. is accordingly generated, causing a current to flow around in the direction of watch hands, without any difference of potential between the different portions of the circle." "The e. m. f. between any two points depends simply on the number of lines of force cut per unit of time, and not at all on any difference of potential."

The conditions here assumed are purely theoretical and can not be verified by experiment, since it is a mechanical impossibility to construct apparatus of absolute mathematical accuracy, which is what is here required. The most perfect circle ever described is only an approximation to the absolute mathematical circle, and its center an approximation to the absolute center. Hence there can be no such thing as an absolutely circular conductor; neither would it be possible to thrust a bar magnet along its mathematical axis so that the lines of force should cut all parts of the ring in precisely the same way. To fulfill these conditions the circular conductor must be mathematically perfect in form, the bar magnet, of some regular form, equally perfect, the material of both absolutely homogeneous throughout, the distribution of magnetism absolutely uniform in cross-section, and the longitudinal axis of the magnet absolutely coincident with that of the circular conductor—conditions which can not be fulfilled; and yet the slightest departure from them vitiates the result. Approximation will not do, since any variation, however slight, produces difference of potential, which it is claimed does not exist. Suppose the axis of the magnet slightly nearer one side of the ring than the other, the result would be a slight variation in the number of magnetic lines cut on opposite sides, and hence a difference of potential; or suppose the axis of the magnet to cross that of the ring at a slight angle, or the ring to vary slightly from a true circle, the same result must follow. The chances are perhaps a million to one, not only that some of these variations will occur in any given case but the several or all of them will combine; so that instead of e. m. f. in this case being not at all dependent on "any difference of potential," it is practically impossible to eliminate difference of potential; and the assumed theoretical condition of "lines of force radiating equally in all directions and cutting all parts of the ring in precisely the same way" never could occur, while the reverse is what always does practically occur; and with an agent of such extreme sensitiveness as electricity, the very slightest deviation, imperceptible to our comparatively gross senses, is quite sufficient to produce the required difference of potential.

There is of course another method of reasoning which may be adopted; if it can be successfully demonstrated by experimental proof, that increase of variation in any of the ways mentioned, as by bringing the magnet nearer to one side of the ring than the other, or sensibly increasing the angle between its axis and that of the ring, produces no increase of current strength, then it may reasonably be inferred that the current is

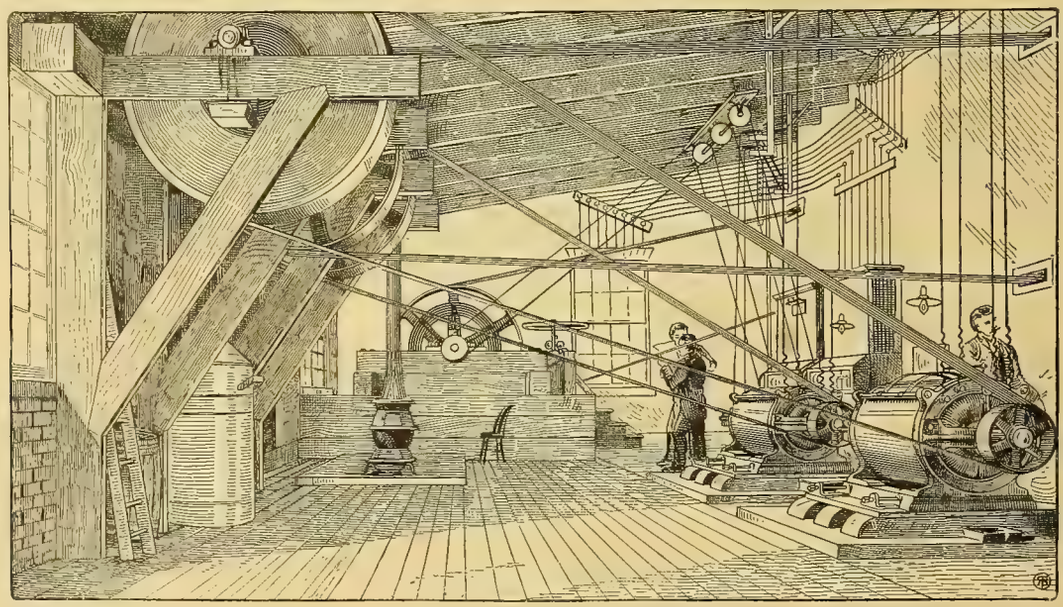

Fig. 1. Heisler Power station at Matteawan.

not due to difference of potential. But mere theoretical assumption, or mathematical reasoning, can not be accepted in the absence of physical demonstration.

Professor Carhart says that in this case "the e. m. f. depends simply on the number of lines of force cut per unit of time." This is true of the dynamo or any instrument operating in a similar manner, where opposite parts of the rotating ring are constantly in opposite parts of the magnetic field, producing a constant difference of potential, and hence a constant succession of momentary electric currents. In such a case increase in speed of revolution increases the number of lines of force cut per unit of time, and hence increases the strength of current by an increase in the number of momentary currents generated in a given time. But there is no parallel between such a case and that of one in which it is claimed no difference of potential exists; and it is not at all apparent why any increase or decrease of number of lines of force cut per unit of time should cause a current in a ring where the forces are exactly balanced in every part, as Professor Carhart assumes; the flow of an electric current in such a ring would seem to be contrary to all the laws of physical force, a difference of force equilibrium being always a necessary condition of motion. The number of lines of force cut per unit of time would not in the slightest degree change the equilibrim which must exist under the assumed conditions.

Professor Carhart further assumes a condition in which the ring is cut and the ends connected with an external circuit; also, one in which a portion of the ring is reduced in size; and, after applying his mathematical reasoning in regard to resistance, concludes that "there may be no difference of potential while there is at the same time an e. m. f. producing a current in a closed circuit." In making either of these new conditions, he necessarily abandons the original condition of a perfectly circular conductor,—"all parts of which are cut in precisely the same way." A conductor in which an external projecting loop is included ceases to be circular, and in the open space between the ends the lines of force are not cut at all, while the loop is assumed to be entirely beyond their range; and in the case of a portion of the ring being reduced in size, it is very evident that a reduced number of lines are cut proportional to this reduction; hence, in either case, there must exist a difference of potential in different parts of the circuit. Indeed, it is not apparent how any test can be applied to demonstrate the existence of a current under the original conditions assumed, without by its application creating the very difference of potential which it is assumed does not exist. It must also be remembered that in all such tests the earth's magnetism is a factor which cannot be ignored; in a large machine like the dynamo this influence may be too inconsiderable to be taken into account, but in such delicate tests as are here required, it may be sufficient to disturb the equilibrium and create a difference of potential.

The ordinary experiment of an electric current generated by the introduction of a magnet into a coil of wire composed of numerous turns, is not a parallel to the case here assumed, as might be supposed, since the wire in such a coil, is wound in a spiral form, so that the lines of force emanating from a magnet introduced end foremost would not cut the rings equally, one part of each ring being more remote, by the thickness of the wire, than the other part, creating a constant difference of potential throughout the entire length of the coil as the magnet advances throught it.

While the writer can not reconcile Professor Carhart's views with sound electric principles, he is not disposed to be dogmatic, and will be glad to acknowledge their correctness, if sustained by adequate proof, and the objections here presented fully and fairly answered.

FIG. 2.

FIG. 3.

The Heisler Plant at Matteawan.

Fifty miles from New York city on the Hudson river are the villages of Matteawan and Fishkill Landing. The streets of the villages were formerly lighted by gas at the rate of about $30 per light per annum, Philadelphia schedule. Though the price was satisfactory the service was extremely unsatisfactory.

William Carroll of Matteawan determined to introduce the electric light and selected the Heisler system. The electrical difficulties to be overcome are intimated in an extract from a letter dated the 2nd ult. written the manufacturing company: "I started on the first of September, 1887, a circuit for street lighting in the villages of Fishkill Landing and Matteawan, having 18 miles of wire, B. & S. gauge number 8 and 170 street lamps and using a turbine water wheel for motive power. On the 22nd of December, 1887, I started a commercial circuit and soon had all the lights contracted for that machine, a 150 lighter, would carry. The third machine a 225 lighter has just arrived and will be started on the commercial circuit in a few days. I have had my share of difficulties—as in every new business—occasioned largely by inexperience—but I am now running on a basis, satisfactory to myself and to my customers, and when I tell you that I have replaced gas lamps costing $30 to $34 per post per year with 20 candle power lamps of your system at $20 per year and, that I am only asking $1 per month for 20 candle power lamps on commercial circuit—other candle power in proportion—I think it will be as gratifying to you as it is astonishing to the representative of other companies, who have visited me. The lamps are white and brilliant and neither the time they have been burned nor their distance from the station affects them."

The cuts in connection are in illustration of the installation in question, Fig. 1 showing the generating station, Fig. 2 a street scene and Fig. 3 representing the territory covered.

In this connection it may be said that Heisler plants are in operation in over 15 miles of circuit in Vincennes, Ind., and in Leavenworth, Kan., and that the Brush company of Salt Lake city and Ogden, Utah, also operate plants of the same make, the power in the latter case being supplied by a water power six miles away from the city.

In Matteawan, as noted in the extract quoted, the electric light has entirely superseded gas for street illumination, is furnished at a considerably less price and gives much better satisfaction. An equivalent of 450 lights of 30 candle power is supplied from one turbine wheel of from 60 to 70 horse power. A man and boy, in charge of the works, attend to all the work connected with the running of the plant. The street lights are of different candle power, the larger ones are placed on the main streets, and the distribution is made with reference to the taxes paid by the adjoining property owners.

The two new steam ships of the Hamburg-American Packet line now building, will be lighted throughout by incandescent lamps. The use of electric lights on steamers carrying passengers is continually on the increase. Their superiority over the oil lamps which were liable to go out at any time in heavy weather, causing a panic among passengers, is appreciated by every traveler.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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IF any one has a direct interest in methods of inflicting the death penalty, it is the murderer who is awaiting execution. A New York journal recently interviewed six candidates for the gallows as to their preference. They pronounced unanimously in favor of the electrical mode because it was painless, certain and instantaneous. It required infinite cheek to ask condemned men how they preferred to die, but their replies are none the less interesting.

ELECTRIC lighting by power derived from an artesian well, as described elsewhere in this issue, is, to say the least, novel and yet not impracticable provided the water supply is sufficient and continuous. It seems that this experiment has been entirely successful thus far. The power appears to be derived from the fall of the water in driving a turbine wheel by which the dynamo is operated. It will readily be seen that a column of water 12 inches in diameter, and having a fall of 35 feet is a power of no mean proportions, too valuable to be allowed to run to waste.

THE lighting of public streets in Rochester, N. Y., by electric light has proved remarkably successful and the city proposes to extend the system. The lamp committee in its recent report to the common council gave as its opinion that the entire city should be lighted by electricity as it had been found to be the cheapest and best system of lighting. Of the 2,951 lights in the public streets 638 are furnished by the Brush company, 231 by the Rochester Electric Light conpany, United States system, and 826 by the Edison company. Of the 220 miles of streets 105 are provided with electric lights.

ELECTRICITY is beginning to find a place for itself in fiction. A story comes from Richmond, Ky., to the effect that Patrick Cunningham has discovered a means of ridding a troubled world of snakes and venomous reptiles of every kind. Cunningham has prepared a lotion which, when swallowed, makes a person serpent-proof. When a snake's fangs strike this liquid in the human body, an electric current is generated, which drives the poison in the reptile's body through every blood vessel in its system, causing almost instant death. This story, dressed up with many attractive details, is published in a popular newspaper as a solemn fact. Cunningham, in the paper, is called a "prototype" of St. Patrick.

THE illuminated fountains to be used at the Brussels exhibition will be of a different character from those used in London and Manchester. Only one very powerful arc lamp will be used, and special effects obtained by the differential rotation of two colored glass discs. The rays will strike a mass of pulverized water produced by revolving nozzles, and by this means a more brilliant effect is expected with only half the power which would otherwise be required. If the effect produced proves only as brilliant as that at Manchester, the fountain will be one of the most attractive features in the exhibition. When the Manchester fountain was illuminated it was always surrounded by an immense throng of wondering spectators who endeavored to explain the methods of producing the changes of color in the streams of water.

THE correspondent "Zeta" whose article will be found in another column takes exception to some of the views expressed in Professor Carhart's article on "Electromotive force and difference of potential," published recently in this journal. Possibly if our correspondents understood each other better their views would not be so much at variance as would now appear; the old story of two knights looking at opposite sides of the same shield is always in point in such a case; our views are largely influenced by the peculiar phase in which a subject presents itself or the standpoint from which we examine it, and it is never safe to insist dogmatically on one's opinions till the opposite side has been fully canvassed. The leading electricians of to-day have not only been compelled to abandon many of the doctrines formerly regarded as sound, but to retract opinions which they themselves once maintained with tenacity.

THE *Gas World* is almost overcome by a prophecy of Lord Thurlow that four years hence not a gas lamp will be left in the streets. From an English standpoint the prediction may be slightly unwarranted but certainly no one in America would consider it audacious. The *Gas World* however in a burst of indignation styles it as "one of the most audacious predictions that ever fell even from the lips of a chairman of a struggling electric light company. * * * Electric lighting men have made many wild and extravagant statements during the past eight or nine years, but we do not recollect any equal to this. The prophecy is so manifestly absurd that we are led to wonder whether Lord Thurlow was in his right senses when he uttered it, or whether he thought he was talking to a number of fools who would believe anything. Apart from any other considerations, the available engineering resources of the country would be unable to achieve such a Herculean task in the time."

THE English postmaster general was recently credited with the remark that the time would soon come when the English government would be obliged to assume control of the telephone system of the United Kingdom. His reason for the statement was that the telephone was becoming daily a more prominent rival of the telegraph and it was unsatisfactory for the government which controlled the latter system to enter into competition with private firms. The remark was withdrawn by the postmaster general a few days later, but not before the announcement had been generally commented upon. There is a division of opinion on the subject and a warm discussion is in progress. It is asserted, on the one hand, that if the government assumed charge of the telephone system the people would be given a better and a cheaper service. On the other hand, it is urged that the government has no right to interfere with a private business. At least, one of the effects of the remark attributed to Mr. Raikes was to increase the price of telephone stock.

MR. ADDENBROOKE, in introducing the description of his reflecting galvanometer, given in this issue, claims that the ordinary laboratory instrument, besides being costly, is unfit for much of the practical work for which such an instrument is required. Practical electricians are often required to make tests under very unfavorable conditions, and an instrument which cannot be easily and promptly adapted to these conditions is practically useless, no matter how elaborate in construction or perfect in its operation. To set up and operate an instrument in a quiet laboratory, with favorable surroundings, and plenty of time, is very different from attempting the same thing in an engine room or factory, in a limited time, and amid the jarring of machinery. If Mr. Addenbrooke has constructed, as he claims, an instrument which can be used under such unfavorable conditions, and which will give results sufficiently accurate for practical purposes, he has done a work which will be appreciated by all practical men engaged in electric installation work; and if, at the same time, his instrument can be furnished at a price which is not practically prohibitive, it will be still more welcome.

THE Rochester *Union* in commenting upon the Oporto Theater fire asks the question "What is the matter with incandescent electric light for theaters?" and adds "It must be very much cooler." It certainly is and it possesses other great advantages of far greater importance. The number of theatrical managers who employ gas is daily becoming smaller. The Rochester *Morning Herald* in answering the question of the *Union* refers at considerable length to the fact that electric light does not vitiate the air in rooms where it is used. The *Herald* adds:

"The great advantages of the incandescent system over all others has been experienced for a long time in the *Morning Herald* establishment which is completely equipped with it and has not a gas jet in it. The benefits are especially noticeable in the composing room where numerous burners are necessary. The difference between the air of this apartment as it was when gas was used and what it is with the incandescent lights is apparent to every one who has had an opportunity to make the comparison, and the change, particularly in the long nights of the winter months when the windows and doors are kept closed, must be of the greatest advantage to the health of the occupants. Among other considerations in favor of the incandescent light are its safety and its convenience. It is impossible for it to communicate fire, and as no matches are used there is no danger from that source. This also is to be considered in the building of a church, public hall or theater. Doubtless gas will have for a long time a field of its own, particularly for domestic use, but for convenience, safety and health it is not comparable with the incandescent electric light."

THE interesting and valuable discussion in the Chicago Electric club upon the comparative value of the alternating and continuous current systems of electrical distribution was continued at the meeting, Monday evening last, by E. P. Warner, whose eminently fair paper will be found upon the following page.

Mr. Warner admits that each system has its particular advantages under certain conditions; but he considers the low tension continuous current system as well suited in every way for distribution over a certain area from a central point, its extent being limited principally by the cost of conductors and the loss of electrical energy in overcoming their resistance. Mr. Warner then goes on and considers the question "why we convert," briefly refers to some of the objects sought in the construction of converters and then takes up some of the reasons why converters can not be worked at high induction, which fact, he says, stands as a bar to progress in the direction of reduction of material. He speaks of loss in electrical energy due to heating of the iron in the converter and the sacrifice in efficiency due to the requirements for self-regulation. Further on he takes up the matter of danger to human life from high tension currents, considers the matter of the high insulation required by high tension alternating currents, safety devices, the efficiency of alternating generators, operation of alternating current dynamos in multiple arc, in fact covers the subject under discussion in a clear, concise and logical manner, and concludes his argument with the expression that he can not help feeling that "the use of converters in a system of electrical distribution is in a certain sense a step backward."

Professor F. B. Badt is announced to read the paper at the next meeting of the club, April 16th on the alternating side of the question.

The prophecy that the discussion of the subject would make valuable additions to the electrical literature of the day is already fulfilled. The papers and discussions by members of the club have awakened a widespread interest in both America and Europe and are made the subject of editorial comments from other electrical papers, reprinted on another page.

Comparative Value of the Converter and Continuous Current Systems of Electrical Distribution.[1]

By E. P. Warner.

Upon signifying my willingness to take part in the present discussion, it was with the distinct understanding that it should be a comparison of direct systems of distribution with converter systems, and embrace any and all systems, applicable to central station work. When the card announcing the programme so far as complete appeared, I was surprised to find the matter to be discussed very indefinitely stated. It seemed, however, to be settled by general consent of the members of the club that the discussion should take the form of a comparison as to value of the low tension continuous current systems with the high tension converter systems of electrical distribution. This reminds me of the numerous discussions of late, regarding the relative value of the high speed, high pressure steam engines, as compared with one of slow speed and low pressure; and viewing the matter as I do from a strictly non-partisan standpoint, it seems to me that the conclusion arrived at will be about the same, that is that each of the systems, as each of the engines, has its particular advantages under certain conditions.

Having followed somewhat closely the progress made in the development of the systems under consideration, I have come to consider the low tension continuous current systems as well suited in every way for distribution over a certain area from a central point, its extent being limited principally by the cost of conductors, and the loss of electrical energy in overcoming their resistance, while the high tension converter systems have appeared to possess certain characteristics that particularly fitted them for long distance distribution, and that seemed their legitimate field of use. I do not propose to night to employ either mathematical or geometrical demonstration, but to briefly go over the points in the two kinds of systems that seem to me to furnish a basis for comparison.

In H. Ward Leonard's paper read before the Chicago Electric club on March 5th, a brief enumeration of the vital points in a supply system is given, which without doubt covers the ground pretty effectually, despite the charge made that he has neglected the matter of distance.

The main features of a low tension system such as the three-wire, are so well understood, and the means for accurate determination of cost, efficiency, etc., are so simple that I will not take up your time in going over them, but say that the statements made by Mr. Leonard regarding the three-wire Edison system are in the main correct so far as my experience goes.

Now for the converter systems. The question might be asked here "Why do we convert?" In answering the question the advocates of such systems are, as a rule, not at a loss for reasons, and put forward claims for the converter of so startling a nature that I can not help the thought that their wishes lead their judgment.

A recently published table of determinations of efficiency of converters under various loads, the result of calorimeter tests by Prof. Ayrton, shows a very low efficiency under light load—a result to my mind very naturally to be expected We know that in the nearest approach to the ideal dynamo that we are able to produce, the showing in efficiency under light load is not all that could be wished, and I think that to a certain extent the working conditions of a converter and dynamo are similar, and many of the troubles encountered in dynamos are met with in the converter; therefore when we take into consideration the number of converters usually employed in an installation of only moderate size the matter becomes one of great importance.

Before proceeding to a consideration of these troubles, it would perhaps be well to mention briefly some of the objects sought in the construction of converters. They are, reduction of length of wire, and number of turns, also the weight and cost of all material used with a high general efficiency under all conditions of service.

The showing has been made that it is not economical to work converters with a high induction, and this fact stands as a bar to progress in the direction of reduction of material. Careful lamination and ventilation of pure, well annealed iron do not to any marked extent improve its storage capacity, and until we find an iron differing greatly in molecular structure from any at present in use we shall probably be without a remedy.

I do not think the statement fair as made by William Stanley at the conclusion of a paper read before the American Institute of Electrical Engineers, that to alternating or similar currents iron offers true storage capacity for all values of magnetization below the saturation point. It seems to me calculated to lead the student astray regarding the economical use of iron for this purpose. He would very naturally take it that so long as he did not pass the saturation point he would be getting a fair return, when as a matter of fact, he must stop far short of saturation, or suffer serious losses from a variety of causes. A large quantity of iron in proportion to wire is therefore a necessity in a converter designed for high efficiency, as the magnetization should at no time reach too high a point.

Another reason for working at a low induction is hysteresis, or molecular friction of the iron core. It has probably occurred to many of the members present that the heating of iron while undergoing rapid reversals of magnetizations could not in all instances be attributable to Foucault currents; also that the heat increased more rapidly than the intensity of magnetization; and again that the heat increased with a decrease in time between complete reversals.

Now, in the case of a converter any heating of the iron means a loss of electrical energy, and it is only by carefully restricting the degree of magnetism of the core, fine lamination, and good ventilation, that excessive heating can be prevented. It seems to be impossible to entirely prevent this loss.

[1] Read before the Chicago Electric Club, April 2, 1888. The third of a series of papers upon the subject "The Continuous Current *vs.* The Alternating Current," before the club.

The requirements for self-regulation of a converter are in practice such as to call for a sacrifice in efficiency in order to secure regulation. This loss is said to be small in certain forms of converters, but it goes nevertheless to make up the sum total.

To quote from an article on "Electrical Distribution by means of Transformers," by J. K. D. MacKenzie, published in the Western Electrician of March 10th: "The question of mutual induction in superimposed layers of wire one with another is of importance, and it is easy to see that since each wire through which an alternating current is flowing serves to induce a current in an opposite direction in the one next to it, which acts against it and against the third or succeeding one, and so on throughout the series, a loss is bound to result."

In considering this point it has occurred to me that this loss must be greater where very high electromotive force is employed in the primary, owing to the greater number of turns of wire employed in construction. I will make use of the words of M. M. M. Slattery, in a discussion which followed a paper read by him at our last meeting: "You are familiar with the alternating current type and you are aware that the greater the number of convolutions of wire, the greater the reactive effect. The same law holds good to a very much higher degree in the operation of the converter, and that is why we keep the number of convolutions of wire in the converter as low as possible, that the ideal converter, as the ideal dynamo, would therefore have but a single turn of wire." We see that in this the electricians who seek to annihilate distance by the use of small conductors and high e. m. f. meet with a serious obstruction.

In the matter of distribution it strikes me that the size and location of converters must greatly affect the results. In the case of an installation of say 500 lights, it has been the practice for some time past to connect the secondaries of several converters in multiple arc to one pair of feeders that supplied the lamps. A rather unexpected trouble has resulted from this method of connecting. Should one of the converters of a group give out at a time when the number of lamps in service exceeds the capacity of the remaining converters, the fuses of these converters will blow out in rapid succession, and all the lights be extinguished. The remedy for this is said to be running separate local circuits for each converter, and at first sight this looks to be unobjectionable, but when we come to the cost of an installation for wire and labor, we can not fail to see that in nearly all cases the expense of running separate local circuits, would considerably exceed that of a single circuit. We can not buy several small insulated wires equaling in conductivity a larger wire at the same price.

Now, as to the dangers to life and property from the alternating converter system, it can not be held that the dangers are no greater than with the low tension system, whether alternating or continuous. Admitting that the safeguard to consumers provided by grounding one side of the secondary or local circuit is perfect, there is still considerable danger from the exposed overhead wire. When we take into consideration the great number of telephone, telegraph and other wires threading the streets of many of our cities, and the frequency with which crosses occur between the wires of the different systems, it becomes a pertinent question whether it will be found possible in practice to provide against accidents of such nature and frequency as to seriously detract from the value of a system. For this reason it may be found inadvisable to raise the e. m. f. above 1,000 volts, or even so high. While it is undoubtedly a fact that a number of persons have taken the shock from an alternating current of 1,000 volts and lived to tell of it, there are many people to whom it would be extremely hurtful, if not fatal. The danger of fire in buildings where the primary wires of a 1,000 volt alternating system are permitted to be placed, is beyond question much greater than with a continuous current system of 200 volts. Again, a cross between a telephone wire and the primary of the alternating system would be almost sure to burn the instrument at the subscriber's station, and might set fire to the building. One thing that increases the danger from this source is the fact — admitted by users — that it is practically impossible to so perfectly insulate the wire that no escape shall take place.

It has been claimed by several writers that if the primary wires of an alternating system endanger a building, so do the wires of an arc light circuit, where the e. m. f. may be as high as 3,000 volts. This is true to an extent, and we all know the precautions that have been deemed necessary by insurance people. But let us look at this matter a moment. In an arc lighting system it is not often that we find 25 lamps in a single building, which number would be required to bring the e. m. f. up to 1,000 volts, and this would only be found from the point where the two wires entered the building up to the first lamp on either side, gradually decreasing as the center lamp is approached. The number of arc lamps in use in a building would therefore determine the danger. I think that in actual commercial lighting the average number of lamps to a building will be found far below 25; whereas with the alternating 1,000 volt system every building entered by the primary wires will be subjected to an even greater danger than it would be from an arc circuit furnishing 25 lamps.

Now to compare the high tension alternating systems with the low tension systems in the matter of insulation. Commencing at the dynamos we find that a much higher insulation is necessary on high than on low tension machines, and leaving out of the question the increased cost for insulating material, it is apparent that much greater care must be taken of the high tension armature in the matter of cleanliness, than of the low tension; also that a comparatively slight deterioration of the insulation of the high tension armature will entail serious loss of energy and where an e. m. f. of 3,000 volts is maintained, this deterioration and loss may amount to a very considerable percentage of the total energy without resulting in the destruction of the armature. To this the advocates of high tension will answer, we will instruct our dynamo tenders to keep things clean, and the insulation will not deteriorate. Many of you no doubt know from experience how instructions instruct, and how frequently the insulation, which is advertised not to, proceeds to deteriorate.

The insulation of the primary wires of a high tension system from each other is a matter of far more importance than that of the armature wire, and in the case of overhead wires, it is found quite difficult and expensive to maintain the insulation at such a point that there shall be no appreciable loss of energy occasioned by leakage. When we consider the number of supports that must be provided for the primary wires, and the average number of converters with, perhaps, their secondaries grounded on one side that offer channels for escape, it is not to be wondered at that grounds are more the rule than the exception. Just here a grave objection to the use of very high e. m. f. comes in; it is, in plain words, that with a given insulation resistance, the higher the e. m. f. the greater the percentage of loss resulting. Suppose, for the sake of illustration, that insulation resistance between the mains of a 2,000 alternating system is 1,000 ohms, the loss would be 4,000 watts, or 5.36 electrical horse power; while in the case of a 200 volt system — insulation resistance being the same — the loss would be 40 watts, about 1-17 of an electrical horse power. The ratio of loss between the two systems, due to defective insulation, would therefore be as 1 : 100. This is a matter that the electrical engineer can not afford to neglect in estimating the general efficiency of a system.

To return to the safety devices and look at them with reference to their effect upon the insulation of a high tension alternating converter system, it has been admitted by an advocate of these systems in the course of this discussion that the practice of grounding one side of the local circuits throughout the systems subjected the insulation of the primary to increased strain, and was for that reason inadvisable. Let us see if it does not do more than this. We will suppose that there is a fair average insulation resistance between the primary and secondary wires of all the converters, also between the primary wires and ground. Now, whatever this may be, the result of grounding the local circuits will be to offer their conjoint resistance to ground, and in the case of a large number of converters so joined, the loss can hardly fail to be very considerable.

Another safety device, the invention of Mr. Kent, I believe, consisted of a metal plate or cover placed between the primary and secondary wires of a converter, but carefully insulated therefrom, and connected to ground. This safey device has the defect that it is purely local to the converter, and does not provide any safeguard from danger arising from crosses between the primary and secondary wires outside of the converter. It is common practice to carry both sets of wires upon the same poles, and any safety device that does not cover this point, can not be said to be perfect. Again, I hardly see how the metal shield can be made to completely envelop the primary or secondary without interfering with the action of the converter to some extent. This, however, is a matter upon which I can not speak from personal experience.

Regarding the efficiency of alternating generators as compared with continuous, it appears to be pretty generally conceded that they are about on equal footing; but in the matter of weight for a given capacity there is—unless very recent improvements have made a change—a slight difference in favor of the continuous machine. Part of this is probably due to the fact that the alternations in a continuous current armature do not take place so rapidly or frequently, and less iron can therefore be used in proportion to wire.

Theoretically there should be no trouble in operating alternating current dynamos connected in multiple arc, provided their reversals take place synchronically. Where they are driven by separate engines it is hard to see how this can be brought about.

I have not touched upon the matter of deterioration of the alternating converter system, as the time at my command did not permit me to obtain sufficient data to prove of use. Placing the wires in a high tension alternating system under ground we must expect to encounter much more trouble from retardation than would be the case with high tension currents if continuous. It is possible to overcome this to a great extent by a proper disposal of the mains with relation to each other, and any iron that may lie within easy reach. But perfection in this would surely add to the cost of a plant.

During the progress of this discussion the assertion has been made that it was not good policy to put in a small plant and increase with the demands of business, and the advice given to put in a plant large enough to meet the expected increase; in answer I would say: It is a well established fact that the maximum efficiency in operation of all steam engines is exhibited when doing full duty, and it has frequently been demonstrated that in cases where the increasing business of a manufacturer called for increased power, it would pay him better to put in several engines, increasing in power by steps as increased business demanded, even if the old engines were given away, than to put in a very large engine at the outset with the expectation that the business would soon grow up to it.

I can not help feeling that the use of converters in a system of electrical distribution is in a certain sense a step back, and is like introducing belting or gearing in mechanical work where direct application would be the wiser and more economical course. We see in modern machinery so many evidences of the truth and force of this remark that I am led to ask again, why convert?

In conclusion, it appears to be impracticable to supply any particular system in all cases, and an impartial consideration of local conditions with the general character of the distribution to be effected should guide the engineer in his choice. The matter is one that should not be lightly decided, and I am hopeful that this discussion may prove fruitful.

Vice President Brown: The paper is now before you for discussion and in discussing it, it is to be hoped that

the members will give due observance to parliamentary forms. I mention this because I noticed an item in an electrical paper reflecting on our methods of discussion. It has not been thought wise to place many restrictions on our discussion hitherto, but at the same time we do not want to lay ourselves open to hostile criticisms; therefore this observation is made at this time.

MR. BUCKLEY: Before entering into the discussion, I move that a vote of thanks be tendered to Mr. Warner for the very able paper that he has given us, and the extreme fairness in which he has treated the question. Carried.

PROFESSOR BADT: I do not care to enter a lengthy discussion of Mr. Warner's paper as I shall read a paper myself at the next meeting, but I will take up a few points suggested.

First—Mr. Warner said that it was the general rule to connect the secondary circuits of the converters in multiple arc. The fact of the matter is that only in the very first plants was this idea carried out; nobody thinks now of connecting transformers in multiple arc for obvious reasons. Transformers thus connected act like two dynamos connected in multiple arc. One transformer may do the total amount of work and get very hot while the other transformer which does no work remains perfectly cool.

Secondly—Mr. Warner then said that the 1000 volt current introduced into houses, as far as fire risks were concerned, was more dangerous than the 200 volt current; I would like to have Mr. Warner state the reason why; it certainly is not obvious.

Thirdly—It was stated that the danger from high tension alternating currents was greater to human life than from arc light circuits and that the number of arc lamps in a building to a certain extent determined the amount of danger. Of course, we all understand that if one arc light requires a difference of potential of fifty volts, ten lamps require 500 volts. But the real danger is caused by the difference of the potential between the earth and any part of the circuit. It don't make any difference in this respect whether there is one lamp in the house or whether there is a hundred.

Fourthly—In comparing the loss between the low tension system and the high tension alternating system, it was assumed that the insulating resistance between the two outgoing wires was a thousand ohms. I do not believe such a circuit should be used at all The rule of the underwriters is that each circuit shall be tested every day by means of a magneto before the dynamo is started. A good magneto bell will ring through at least 10,000 ohms. Of course, the insulating resistance between the two wires can not be tested. But, if the insulating resistance between each wire and the earth is over ten thousand ohms there is certainly the probability that the insulating resistance between the two wires is much higher.

Fifthly—The weight is said to be in favor of the continuous current dynamos. I think that is true; but in order to set this matter right it should be mentioned that the increase of weight in the alternating dynamo is caused by the increase of iron merely. The alternating dynamo has a great deal less copper wire than the continuous current dynamo especially in the armature. As iron is cheaper than copper I do not think that the total weight should be considered in this comparison.

I notice with considerable joy that Mr. Warner has left a little room for the alternating system; he said he thought that each system would find its proper place.

MR. WARNER: In answer to the professor in regard to the danger by fire, I would say the danger I referred to was that which would result from any metallic substance forming a cross made momentarily between two mains in the high tension converter system. It would undoubtedly be followed by a flash which would set fire to the building.

Now with regard to the danger from arc circuits forming a ground in the building; it is seldom indeed we find an arc circuit to-day used for commercial purposes in which the e.m.f. exceeds two thousand volts. It is a question in my mind if a dead ground occurs near the dynamo and another contact with the earth takes place near the other end it would be as likely to result in fire as would be the case where high tension alternating mains were introduced into houses.

We will suppose, for instance, a large number of small wires—small distributing wires of various kinds. It not unfrequently happens that crosses occur between those different systems of wires, and it certainly must be conceded that with one thousand volts, with almost any kind of wire that is used in distribution around buildings, the general result would be to overheat the wire almost instantly; whereas with the arc system such a wire on a short circuit with a large number of lamps would still not overheat; the resistance around these would be so low that the shunted part of the current of the circuit would not be sufficient to overheat it.

PROFESSOR BADT: I am sorry that I have to ask Mr. Warner again for the reasons why a 2,000 volt alternating current is more dangerous, so far as fire is concerned, than a 200 volt direct current. I can not see why it should be. We all understand how the wires in the low tension direct system are protected; safety strips are put in to protect the wires. The safety strip has to be of such a cross section as to melt before the wire it has to protect can get dangerously hot. Now if the same thing is done in the alternating system, no matter what the electromotive force may be, why will this protection not be just as good as the other?

MR. WARNER: The provisions that are made ordinarily in the matter of safety for high tension alternating systems are not such as to prove, in my opinion, as great a protection, or safeguard, as those made in the low tension, 200 volt system. For instance, the mains upon entering a building are connected to a converter that is intended to supply a certain number of lamps. If a short circuit should take place in those mains, in the place where they enter the building, the result would be to heat the wire to such an extent as to set fire to the building without blowing the fuses of the main wire for the reason that they are beyond the place of the short circuit and the wires leading from the mains to the converter are not protected. The high electromotive force would be certain to produce that, while in the case of a two hundred volt system, the wire could not approach a dangerous degree of heat on account of a a short circuit because the fuses would be blown out.

PROFESSOR BADT: Let us consider two analogous cases: First, a continuous current system of wires running from the mains into the houses, then through the safety devices, and finally to the lamps, with no safety device between the mains put up on poles and the point where the wires enter the safety devices; Secondly, two wires running from the high tension mains carrying a current, say, of one or two thousand volts, into the house through the walls, then into the converter, with no safety strip between the mains and the transformer. Now we assume in both cases that a short circuit is caused by a falling wire or by moisture between these two wires running from the pole line into the house; there are no safety strips between pole line and house to protect it from that cause, in either case. In the case of the low tension continuous current system, there is absolutely no protection whatever. If the wires touch each other or get short circuited they will get overheated, or an arc may be formed. What will be the result? Even if the main to which those small wires are connected should have safety strips, they would be too large to melt before the wire will get overheated.

In the case of the alternating system it must be remembered that the current strength is very small, and that these primary mains are protected by safety strips at the station. These safety strips will in most cases carry not more than say, twenty or twenty-five amperes. A No. 9 wire is used from the primary mains to the converter; of course it is not necessary to have such a large wire to carry the current, but a larger wire is used in order to stand rough usage, and a certain amount of strain. If these two wires come in contact or get crossed by a falling wire the safety fuses of the main will blow out. These are very rare occurrences however, as in most instances transformers are placed on poles. If they are placed on poles and not in the houses, this slight objection could not, of course, be raised. But I think even if they are placed in the houses, that the wires leading to the transformer from the outside mains are less dangerous than the wires of a low tension system, leading from the mains to the safety strips placed inside the building.

MR. ANDREWS: I think Brother Badt is quite right in the position he takes. It is a good deal more dangerous to take a low tension system into a house without any protection than a high tension current wire. I think the discussion has been prolonged upon points which are a little too fine, because in my experience I have never seen the high tension wire brought into the house; in every case they put the converter, with the high tension wires on the outside of the building; I don't know why it can not be always done, in fact I have always seen it done. Then we avoid what I think a greater danger than fire, the danger of persons meddling with the mains and converters. If this is placed in the house it can be inclosed in some place so that it will be impossible to handle it.

I think one of the first things that should be looked after in placing converters, and which is a very vital point in regard to the system is, that they should always be put in places where they can not be handled, except by experienced men who attend to them, whose business it is to attend to them in order to fix the wires. I think it is very hurtful in business to bring high tension currents into houses by placing the converters inside. I think in every case where it is possible to find a place on the outside it is better to do so, and avoid the appearance of evil, if not the actual existence of the danger.

MR. WARNER: It is not an uncommon practice to connect the secondary converters in multiple arc. In a recent visit to Steubenville, Ohio, I saw a great many converters of the Westinghouse system used in that city, so connected and used for street lighting and other purposes. At that time they did not seem to think the matter very dangerous, but I understand they have made some changes in their circuits. In conversation with a party interested, I understood while it did not entail a very great expense for wire it was an expensive piece of work on account of labor.

MR. LEONARD: Mr. President, there are two points that struck me, as Mr. Warner read his paper, as being worthy of a little further comment. The first was the lack of efficiency in the dynamos and converters. He spoke of them as being rather comparable. I do not think they are comparable. In any continuous current system of distribution commonly in use, the dynamos or converters in operation can be kept fully loaded at all times. The number of dynamos in operation can be graduated so that those that do run can be operated at the highest efficiency; converters can not be made to operate in this way. Every converter in service must operate from its minimum to its maximum load and in the course of twenty-four hours the converters would have a very large output made with a very low efficiency.

The matter of reliability is, of course, of the utmost importance. Multiple arcing of the secondaries from the different converters on one generator tends to increase the reliability of operation of the lamps in an alternating system as, in case of trouble to one converter, it might be expected that the remaining converters would take up its work without injury to themselves; but even the reliability to be attained in this way is not possible in the alternating system, both on account of the fact that the converters will not divide the load proportionately among themselves and also on account of the fact that the greatly increased cost of construction due to multiple arcing the various 50 volt two-wire circuits at long distances from each other makes such multiple arcing impracticable.

Electrical Press Comments.

ALTERNATING VS. CONTINUOUS CURRENTS.

The Electrical World, March 31.

At the present time the field of the controversy as to the relative values of the alternating and continuous current is in Chicago, where a lively discussion is now going on, and is taken part in by several well known electricians. In a recent issue we published the conclusions arrived at by H. Ward Leonard, who, taking up the question on behalf of continuous currents, showed what the advantages are and the distance to which each form of current could be practically operated from central stations. Without entering at this place into these details again, it is interesting to note what those on the other side of the question bring forward to meet the objections raised by Mr. Leonard to the alternating system. Mr. Slattery, in answer to these, lays particular stress on the fact that Mr. Leonard's assumptions and data are incorrect, and that he did not include in his list of vital factors in a general supply system the fact, according to Mr. Slattery, that the alternating system can reach customers and supply a market that the low tension never can. Again, according to Mr. Slattery, Mr. Leonard assumed the cost of copper to be 16 cents per pound, which he was compelled to do in order to bring his estimates within bounds, whereas Mr. Slattery states the price of copper to be nearer 25 cents than 16 cents; and this variation of the price of copper affects the low tension system much more than the high tension altering. On the question of location of plant Mr. Slattery also drew attention to the fact that whereas in a low tension system the station must be located in the center of the district to be lighted, thus often necessitating the purchase of valuable property and entailing expense on account of its distance from its source of coal supplies, the alternating high tension station on the contrary may be placed entirely to one side of the district to be lighted and much expense be thereby avoided. Mr. Slattery also took up the other objections raised by Mr. Leonard to the alternating system, such as the inefficiency of the converters at small load and the difficulty in coupling dynamos in parallel, as well as others, and claimed that these difficulties either did not exist, or, if they did, could be overcome, and had already been overcome to a great extent.

DEFENDER OF THE FAITH.

Modern Light and Heat, March 22.

The advantages of the Edison system of incandescent electric lighting, were ably presented by H. Ward Leonard, in his interesting paper before the Chicago Electric club, on the 5th inst. The paper made no pretensions of coming from any impartial or critical source and the Edison system was posed in its most favorable attitude and was compared with other systems, the audience being left to judge for itself, if the competing systems were also posed in a favorable light. In selling strawberries it is always permissible to place the largest ones on top, but if while so doing we beseech the public to notice that our competitors have also done so, we need not be surprised if our rivals observe that they have only been following our example. That the alternating system of electrical distribution has come to stay, is so evident to those who do not "see through a glass darkly" that any attempt to frighten it away, with an exaggerated phantom of its own defects, seems to us about on a par with, and about as efficient, as the time honored efforts of the Japanese to frighten away the devil with a hideous picture of himself. Well.—the alternating system may look like a hideous nightmare to some people, no doubt it does, but then the whole community cannot be expected to see it alike.

From the above we do not wish to be construed into implying that the gentleman has used unfair means in advocating his particular system, yet one might venture to criticise some of the arguments if he were disposed to do so.

That the Edison parent company counts among its staff some of the most distinguished electrical experts and some of the longest business heads in this country is not to be doubted; that its apparatus in all of its ramifications is a marvel of ingenuity and applied science, even its bitterest rivals will willingly admit; that many of itsllocal companies are finely equipped and managed by skilful and intelligent men goes without saying; that the advantages of its system have often been ably argued, as for example, by Mr. Leonard is familiar to every one; but that the alternating system can be crushed out of existence by any means other than a superseding and superior system which has not yet been invented, no man familiar with it believes.

A thorough airing of the disadvantages of the various systems as viewed through their rivals' eye, has the advantage of settling public opinion as to where each system should, and should not be used.

Green vs. Van Depoele.

A press despatch announced a few days ago that Nelson G. Green had brought an action in New York against the Van Depoele Electric company to obtain $1,320,000 for acting as broker. He alleged that he was engaged to secure money for organizing a company to transact the motor business of the Van Depoele and that his fee was to be $320,000 in cash and $1,000,000 in stock. At the hearing April 2d Green was accused of obtaining money by false pretenses and with making a contract under false pretenses. It was charged that Green, alleging himself to be a wealthy capitalist and retired lawyer, representing a syndicate of well-known business men, offered to the Van Depoele company of Chicago to secure moneys and purchase stock; that Green went to Chicago and persuaded William Clarke and the president of the Van Depoele company, to retain his services as broker in the transaction; that Green went to Brooklyn and represented himself to E. W. Bliss, a well-known capitalist, as agent of the Van Depoele Electric Light company, and

on Feb. 15, 1888, obtained from Bliss an agreement to do certain work for the Van Depoele company and tried to induce him to purchase stock to a large amount; that Mr. Bliss started for Chicago in company with Cyrus Clarke, William Clarke, and Green; that while in Chicago Green had borrowed $700 for expenses; that on the way to Chicago Green and Cyrus Clarke quarrelled; that Green then proposed to William Clarke, the Van Depoele man, a plan by which they were to swindle Mr. Stiles out of a large amount of money, that the proposition was indignantly rejected, and that Green then refused to carry out his agreement with the other members of the party, alleging that the Van Depoele company was insolvent. This suit is expected to fall through by those acquainted with the facts. It will have no bearing on the recent transfer of the motor business to the Thomson-Houston company.

Heating of Wires by Electric Currents.

The extended use of fuses in electric light installations has rendered the question as to the heating of wires by electric currents one of considerable practical importance, and the results of a long series of experiments made in this connection by W. H. Preece, F. R. S., were recently submitted by him to the Royal society. The experiments were taken for three temperatures: First, the melting point of shellac, which is 77°C.; second, the point of self luminosity, which for all substances may be taken as 525°C.; third, the fusing point, which is different for the different metals. Mr. Preece experimented with wires varying in thickness from 4 to 40 mils., and comprising the following materials: Copper, aluminum, platinum, German silver, platinoid, iron, tin, lead, and an alloy of tin and lead. For wires varying in diameter between 10 and 40 mils., the current which produces a certain temperature is for each wire given by the product of a constant, and the diameter to the power of $\frac{3}{2}$. For smaller wires than 10 mils. this formula does, however, not hold good, and the current is more nearly proportionate to the diameter. In order to eliminate errors due to the cooling effect of the terminals, the samples experimented upon were 6 inches long, being clamped between terminals upon a dry wooden stand; but a second series of experiments were also made for wires stretched between terminals 1¼ inches apart, so as to determine the fusing point of short wires such as are used in commercial cut-outs. Mr. Preece arrives at the conclusion that the best metal to use for thin wires is platinum, and for stouter wires, tin. Platinum fuses like wax without explosion or scattering of molten particles, and tin in moderately stout wires behaves in a similar manner. Mr. Preece doubts, however, whether large wires should be used at all for fuses, because, owing to radiation, the surface keeps cool and solid, while the centre is liquefied. The wire then bursts with an explosion, and incandescent particles are scattered in all directions with considerable energy.—*Industries.*

Long Distance Telephone Lines.

It was a remarkable fact that when New York telegraph service was shattered by the blizzard the long distance telephone was in excellent working order. The reason is given in the following interview, quoted from the New York *Sun*, with Superintendent Angus S. Hibbard:

"Let me tell you, in brief, some of the reasons why the long distance telephone lines stood up throughout the blizzard. In the first place they are the very best lines of electrical conductors ever built. Forty-five to fifty sound and straight poles are set to each mile instead of twenty-five to thirty, the number allotted to the mile by ordinary systems of telegraphy.

"Again, the poles are tamped or set six to eight feet in solid ground, instead of four feet. No expense is spared in rigging the plant. Braces and guy wires are used wherever needed. All cross arms are braced by two iron braces bolted to the pole. Carefully inspected hard-drawn copper wire is used on all circuits.

"Finally, no expense has been spared to make the lines perfect. The equipment is of a character to handle the commercial business of the territory which the lines traverse. The results were shown during the recent storm, the severest test ever known. Why, just think of it! During the great blizzard not a single one of our 24,000 poles went down, and comparatively few wires were disabled over the long distance circuits. What trouble we had was within New York city itself, where the long distance wires are carried on poles belonging to the Metropolitan Telephone and Telegraph company. Those of our Boston and other eastern wires which were disabled, were up forty-eight hours before those of the Western Union company."

Power for Lighting from an Artesian Well.

H. Bradford Rockwood, writing to the *Scientific American*, from St. Augustine, Florida, in regard to H. M. Flagler's new hotel, the Ponce de Leon, says: "It will perhaps be of interest to mention an experiment which Mr. Flagler has been trying, in connection with the great artesian well which was, a few months ago, opened on the hotel grounds. Directly over the well, which throws a solid column of water, 12 inches in diameter, 35 feet into the air, a huge turbine wheel has been placed. Bolted direct to the shaft of this wheel is an Edison dynamo, capable of supplying 375 sixteen candle lamps. Several hundred Edison incandescent lamps have been placed on the walls of the building over the well, and together with the indicating and regulating apparatus connected with the dynamo. The trials in generating electricity by this way by power derived directly from the earth have proved eminently satisfactory, as far as the steadiness and constancy of the light are concerned; but the power secured has not been so great as was at first anticipated. This, in great measure, is due to the method in which the stand pipe is connected with the turbine, and to the arrangement of the paddles in the wheel, which allows a great deal of water to pass by. Changes are now being made which will obviate these troubles, and it is expected that when these are completed, the steam plant can be shut down late in the evening and not started again until early the following evening, the hydraulic plant furnishing all power necessary for supplying light in the interim. Hydraulic experts throughout the country have condemned this scheme as impracticable, and have doubted the constancy of the flow of water from the artesian. This, however, has not in three months perceptibly diminished. The experiment is interesting, as being the first case on record where natural water power for driving machinery has been derived directly from the earth. It has been conducted under the supervision of Wm. Kennish, an expert in hydraulics, and W. J. Hammer, of Boston, an electrical expert connected with the Edison Electric Light company, and who is in charge of the entire department of lighting at the Ponce de Leon."

Lag in Transformers.

As the subject of transformers is now exciting much attention, it may be interesting to mention without now going into the details of the experiments that the investigations of the third year students of electrical engineering at the Central institution made on a closed magnetic circuit transformer have shown:

1st. That the lag between the currents in the primary and secondary circuits is practically 90° in excess of what it would be if there were no self-induction or magnetic lag—that is, the currents in the two currents are nought simultaneously.

2nd. That the magnitude of the ratio of the coefficient of self-induction of the secondary to its resistance is a sufficient and necessary reason for this extra lag of 90°.—*London Electrician.*

The Copper Market.

"Business is dull" said a dealer in wire to a representative of the WESTERN ELECTRICIAN. "No one however need look for a fall in the price of copper. The syndicate that controls the market has too much capital back of it to lose its grip within six months. The consumers of copper are waiting now, thinking it will become cheaper. They will put off buying until their stock is almost exhausted. Then they will come in with a rush and probably their demands can not be met at once."

Magnetization in Steel Bars.

G. Berson, says the London *Electrical Review* gives the results of researches which he has made on the variations of magnetization in steel bars, produced by blows. Experiments were made on a bar 9 millimetres in diameter and 25 centimetres long, the bar being submitted to blows from a mass of 2,400 grammes falling from various heights. In the first case the bar was placed perpendicularly to the magnetic meridian. In this case the magnetic moment of the bar became diminished by the effect of a blow towards a certain limit which was dependent upon the initial value of the magnetism, the temper of the steel, and the strength of the blow. The rate of diminution diminished gradually in proportion to the number of blows, the relative values being represented by a hyperbolic curve of the form $y=a+\frac{b}{x+c}$. Experiments were also made on an unmagnetized bar in the same position; in this case it was found that after the first blow the difference between the magnetic moments produced by the same number of blows of different strengths is sensibly the same, independently of the number. The law connecting the magnetic moment produced by a single blow with the height of the fall of the mass is given by an equation of the form $y=\frac{a\,h}{h+b}$, an equilateral hyperbola.

Kansas City Telephone Exchange Statistics.

W. W. Smith, general superintendent of the Missouri & Kansas Telephone company at Kansas City, Mo., has recently been gathering statistics in regard to the work of the exchange that are very interesting and valuable. An extra operator was connected in circuit with the working operator and each board of 100 numbers was counted for a day. As there are 22, 100-number boards it required 22 days to complete the count. The count was also kept to determine which were the most busy hours of the day and the tabulated results appended determine them beyond doubt:

From	Connections.	"Busy" Calls.	Percentage of "Busy" Calls.
7 to 8 o'clock	339	26	7.6
8 to 9 "	1,632	171	10.4
9 to 10 "	2,673	350	13.
10 to 11 "	2,626	360	13.7
11 to 12 "	2,363	302	12.7
12 to 1 "	1,521	97	6.3
1 to 2 "	2,254	239	10.6
2 to 3 "	2,457	322	13.
3 to 4 "	2,368	311	13.1
4 to 5 "	2,198	265	12.
5 to 6 "	1,561	178	11.3
6 to 7 "	546	22	4.
Total	22,847	2,686	11.7

Average number of connections per operator 952.
" " " " " subscriber 10.

A Place for Electric Motors.

To the Editor of WESTERN ELECTRICIAN:

CARTERVILLE, Mo., March 29.—I wish to inquire if this part of the great electrical vineyard is not being neglected. I refer to the application of electricity by motors. I understand the Center Creek Co. contemplate pumping from three of their shafts by power from a central station, using "string pumps"; one string will necessarily be ¼ mile long, and a second about ⅛, the third near the engine. I have believed for a long time that a central power station should be adopted, but had in my mind the use of dynamos and motors, but being ignorant of their first cost have never advocated it. The engine, a 150 horse power Corliss, is here on the track. The total power demand of the company is for driving at each of two shafts a pair of 12-inch single acting force pumps or their equivalent, and at three other points a pair each of 8-inch pumps, also a set of steam jigs say, 20 horse power. There is a possible chance for rental of power and use of small hoisting motors—most of the hoisting is now done by horse power. Should this prove of interest to any electrical man, the location is Webb City, Mo. JAMES M. TYLER.

As the result of 18 months' experimenting, it is claimed that the electric formation of the plates of the Epstein secondary cell can now be accomplished in four hours instead of requiring several days as formerly; considerable improvement has also been made in their mechanical construction.

CORRESPONDENCE.

Indianapolis Items.

INDIANAPOLIS, April 2.—The city of Indianapolis is probably behind almost any other city in the country in the use of electricity in any way, but from present indications there will soon be an improvement. The city has never used the electric light for street lighting. The Indianapolis Brush company is furnishing in the neighborhood of 250 arc lights for inside and outside display. There are also a few individual firms who have their own plants; among these are the Model Clothing company who have just completed a plant, having two 20 light Brush arc dynamos and one 25 light incandescent dynamo with an Atlas engine. They light their own immense store, besides supplying light for four other business houses in the same square; the Bates, Denison and Spencer houses, also the Grand hotel, each have their own incandescent plant. The city's contract for street lighting, with the Indianapolis Gas company expires the latter part of April and the city council has notified the company it will not renew the contract. The present intention is to light the city by electricity. There are now in use 2,500 gas lamp posts, besides a large number of vapor lights, which cost the city $75,000 to $80,000 annually. It is thought by use of electricity more light can be secured for less money.

The city engineer has completed a schedule for lighting the city and only awaits the action of council to advertise for bids. There are already several representatives of electric light companies, from abroad, in the city looking into the matter. There is also some talk of one of the natural gas companies putting in an electrical plant, though no definite understanding has been arrived at.

One of the city papers publishes the following interview with the mayor on the subject:—"If the public will only let us go slowly, and not be too much in a hurry, I will guarantee that the municipal bodies will do the right thing in regard to the electric light business. I am much pleased with the general feeling about the subject, and I don't believe that if the gas company were to come to terms now that the contract would be given it. Nothing definite, however, can be done until the council concurs in the action of the board of aldermen. One good feature of the schedule proposed by the engineer is this: He has adopted three different methods of advertising for bids. First, the electric light companies will be required to bid on a basis of 2,500 hours, which is the minimum number of hours that the streets will be lighted; then, on a basis of 2,740 hours, which is the present basis, and last for 3,700 hours, which will include every night in the year, moon or no moon. One great advantage to be derived from electric lighting is that the city can be lighted on cloudy nights when the moon is supposed to shine. An attempt will be made to make an arrangement of this kind. I think within six months from now Indianapolis will be lighted by electricity, which will place her in advance of most of the cities of this country."

The Indianapolis *Sentinel* company are making extensive improvements in their building, among which which will be the introduction of an incandescent plant for lighting the whole building.

The Citizens' Street Railroad company have secured permission to extend their line to Crown Hill cemetery and are looking into the subject of electricity as motive power with the intention of equipping the new line with electric motors. M.

New York Notes.

NEW YORK, March 31.—One of the few places where an affirmative answer is often given to the question, "What can you show us that is new!" is the factory of the Elektron Manufacturing company, where Messrs Barrett and Perrit design and manufacture specialties for the electrical trade. Mr. Barrett is now engaged chiefly in putting his chloride of silver cells into shape for various new and practical uses. The perfection to which he has brought this form of battery, after years of experimenting, is surprising to those who see it for the first time. The obviously great advantages over other open circuit batteries are many. No fluid is used, a paste of low resistance being substituted. For almost all purposes, the little cells are sealed, with auger holes bored in a solid block of wood; of course there can be no evaporation and the batteries are not at all affected by any amount of handling or rough usage. Then again the cells give a constant current until the elements are entirely exhausted, and when exhausted they are not worthless, as porous cups, but can be renewed again and again at a fraction of the original cost. The cells are so small that a battery equal in power to several LeClanche cells can be sent through the mail for a few cents postage. Heretofore the Barrett battery has been used chiefly for medical and testing purposes, but the field is widening and the company expect to largely increase their telephone and electric bell business. On account of its compactness and constant current, this battery is especially adapted for use with telephones. Mr. Barrett states that a small cell which we noticed on top of the transmitter of the telephone set in his office had operated that instrument in the Brooklyn telephone exchange service for several months, and that the microphone had not even required inspection or adjustment. Another specialty of the Elektron company is the motor designed by Mr. Perrit. It contains many advantageous features not found in other motors, and is giving satisfaction wherever used. Different sizes can be seen in operation at the New York office of the company, on Nassau street.

The Laramie Milling and Elevator company's flouring mill at Laramie, W. T. having a capacity of 100 barrels of flour a day, is equipped with steam heat, Edison electric lights and Sprague motors. Attention has been frequently called to the successful installation of large motors for power, and that they are particularly well adapted for use in mills is shown by a recent letter to the Sprague company from the proprietors of the Laramie mill from which quotations are made: "The Sprague motors are used exclusively as the power to drive the mill, and are giving entire satisfaction. One motor drives the rolls; another motor drives the purifying machines and elevators, as these must travel in unison, and another drives the packing and cleaning machines!" The millers state that the motors are more constant and meet any sudden change in load with greater accuracy than the best regulated automatic engines they have ever seen. "Prior to using the motors power was distributed 300 feet by belts and shafting, and we do the same work now with 20 horse power we then did with 50 horse power. The entire mill is a great success, and we advise millers everywhere to adopt the Sprague motor system. They will get an evenly distributed, well balanced and perfectly controlled power, and an economy of not less than 50 per cent over any system of transmitted energy with which we are acquainted."

The Okonite company is building up a considerable trade in the saturation of cotton covered magnet wire with a peculiar compound of its own manufacture, which is an excellent insulator and is not affected by heat. This property makes the saturated wire especially valuable for use in winding the armatures and field magnets of dynamos, and it is now used exclusively by the American and other large electric lighting companies.

R. F. Ross, the genial manager of *Modern Light and Heat*, has been seriously ill at the Astor House this week. A.

No Tower Fell at Berkeley, Cal.

BERKELEY, Cal. March 23—Your correspondent for the Pacific slope makes a statement that a 125-ft. tower fell here during erection and that two men were injured. Allow me to state that there are no 125-ft. towers here, all being 100-ft., and that not one of them fell and that no one was injured while working for the company.

CLAUDE LOVEDAY.

From Detroit, Mich.

DETROIT, March 31.—"An official exposition of the precise situation of affairs" is the title of a 200 page document that is shortly to be submitted to the council as the result of the labors of the special electric light committee, relative to public plants, underground wires, etc. The report shows the experience of New York, Philadelphia, Chicago, Brooklyn, Boston and Washington in putting wires underground. The failures and successes are noted, and a description and statement of cost of methods that have been received with the most favor are given. Apart from the statistics relative to cost, heretofore noticed in these columns, there is little in the report of any practical value.

The Ionia Electrical company, capital $25,000 has been incorporated. C.

Notes From Kansas Towns.

TOPEKA, Kan., March 31.—The Topeka Edison Electric Light company will probably extend its wires to Potwin this summer. The company is now operating its full capacity and running between 4,000 and 5,000 lights. During the coming season the company contemplates building an extensive addition to its present building, putting in a large amount of new machinery and enlarging the capacity of the plant at least 100 per cent. The Jenney Electric Light company has filed its bond with the city clerk. The bond prepared by the city attorney covers the fulfilment of the contract made by the city council for an electric light plant.

An electric company has been formed at Seneca, and the light will be introduced before June 1st.

The Wellington Electric Light company, whose plant is now operated in connection with the Wellington foundry and machine shops, will erect a large and commodious building this spring.

Florence has contracted with Elias Kapp for the establishing and maintaining of an electric light plant in that city, stipulating that it is to be completed and in operation on or before the first of May next.

At a meeting of the directors of the Electric light company of McPherson, J. B. Darrah was elected secretary and treasurer in place of B. A. Allison, who resigned. McD.

THE ELECTRIC LIGHT.

The company which manufactures the Seel glow lamp in Berlin is about to considerably enlarge its works. The lamps have proved so economical and lasting that the demand has of late greatly increased. With the new plant the time required to evacuate the lamps will be much reduced, and the loss of quicksilver, sometimes occurring through breakage of the old Sprengle pumps, is also said to be avoided. It was often found that when a pump broke, quicksilver found its way into the clothing of the workpeople, and to protect them from such accidents, which are prejudicial to health, the pumps will be placed outside the work rooms. In adopting this precaution the company has anticipated the objection which sooner or later is sure to be raised by the sanitary authorities against the indiscriminate use of quicksilver in the manufacture of incandescent lamps.

St. Paul's cathedral, London, is soon to be lighted by electric light.

At Pomeroy, O., a proposition has been made by E. S. Trussell, to light the streets with incandescent lamps; if it is accepted, a plant will probably be put in at once and commercial lighting be engaged in also.

The Consolidated Electric Light Gas and Power company of Woodland, Cal., has been incorporated with a capital of $100.000.

The *Roller Miller* says, "The electric lighting of flour mills continues on the increase, and is being steadily reduced in cost. Time was when none but rich millers could afford an incandescent outfit, but now many find they can reduce expenses by putting in one. We counsel all millers who are still enduring the semi-darkness and constant danger of kerosene lamps or gas jets to bestir themselves ere this year is much older, and find out how safe and economical a thing the electric light now is."

The Newburg Electric Light company of Newburg, N. Y., of which Anton V. Wiltsie was formerly treasurer, has had judgments entered against it in New York aggregating $49,102. This was caused by the failure of the banking and insurance firm of John R. Wiltsie & Co., of Newburg, whose doors have been closed, and

whose business was taken possession of by an assignee. The assets and liabilities are not stated.

A letter from Brussels states that M. Vlierboom has fitted up a house in the Boulevard Bischoffsheim with the electric light. He uses twenty Gadoh accumulators of 44lb. each, including the weight of the glass cells. Each cell contains nine plates. The daily discharge of the battery is about forty ampere-hours, but reaches occasionally sixty. The battery is charged from a Gerard dynamo driven by a 1 h. p. Körting gas engine. In another private installation twenty-five Gadoh accumulators, weighing altogether 10cwt., are used for thirteen Khotinsky lamps of 1 ampere and 50 volts. The dynamo is driven by a 2 h.p. Lenoir gas engine.

The Paris superior committee on theaters, is conducting a series of experiments to test the safety of the incandescent lamps in places of amusement. Thus far the immense superiority of the electric light has been demonstrated.

That England is behind America in point of electric lighting is well illustrated by the fact that only seven towns in England illuminate public streets by electric lights.

The Chicago Edison company announce that they expect to be ready about May 15th, to furnish both light and power from their central station on Adams street, near LaSalle, within the following district: Van Buren street on the south, Franklin street on the west, State street on the east, Randolph street on the north, between Franklin and Clark and Clark street north of Randolph to Lake street. The officers of the company are: Anthony F. Seeberger, president; J. W. Doane, vice-president; D. H. Louderback, general manager; F. S. Gorton, secretary and treasurer; directors—J. L. Thompson, Robert T. Lincoln, John B. Drake, J. W. Doane, P. L. Yoe, F. S. Gorton, Edson Keith, A. A. Sprague, R. C. Clowry, E. M. Phelps, Anthony F. Seeberger.

The Hotel Ponce de Leon at St. Augustine, Fla., is lighted by a large Edison plant. There are three dynamos each 640 light capacity, run by three Armington & Sims engines of 60 horse power each and two more Edison dynamos run by a fourth engine of the same make of 125 horse power. Steam is supplied by four Babcock & Wilcox boilers nominally 107 horse power each.

The annual report of the lamp committee of the Rochester, N. Y., common council covers the following principal items of expenditure: Electric lights, $63,434.91; gas, $28,023.66; superintendent of electric lights, $600; oil lamps, $569.64; setting posts, $117.01; removing posts, $160.20; lamp cocks, $136. The report also shows that there are 2,951 lights in the public streets of the city, of which 638 are furnished by the Brush Electric Light company, 213 by the Rochester Electric Light company, 826 by the Edison Electric Light company, 640 by the Citizens Gas company, 405 by the Rochester Gas company and 229 by the United Gas Improvement company. The electric lights include 851 arc burners and 826 incandescent lights. Of the 220¼ miles of streets in the city 105 miles have electric lights, 37 miles have gas and 78¼ miles are without light of any kind. The committee was of the opinion that the entire city should be lighted by electricity.

Last Sunday night Easter services were held at Christ church Chicago, for members of the Sunday-school. The floral decorations were profuse and were brilliantly illuminated by electric lights supplied from accumulators. A special feature of the decorations was a large artificial egg, which at a given signal flew open, showing electric lights hidden within. Twenty 24 volt lamps were in use.

THE ELECTRIC MOTOR.

It is stated that an electrical railroad is to be constructed from Voslau to Leopoldsdorf, near Vienna, a distance of twenty-seven kilometers. Accumulators will be used.

The trials of electrical traction by means of Julien accumulators at Brussels have given excellent results. The accumulators are placed under the seats of the cars and each car is furnished with two batteries.

A company has been formed in Berlin to manufacture electrical watches. Two small cells and a small electric motor take the place of the ordinary movement.

The Rockford, Ill., Electric Power company, has increased its capital stock from $30,000 to $70,000.

The first trial of the Vevey-Montreux electric road in Switzerland, was entirely successful.

M. Berlier has presented to the Paris municipal council a plan of constructing an underground electrical railroad. It is said the scheme is so feasible that there is a prospect of its adoption.

A project of constructing an electric railway, connecting Wellington, New Zealand, with the termini of the various lines of railway in proximity, is under consideration.

An important clause in the Chicago city ordinance granting the street railway company on the west side of the river permission to cable their lines is: "Permission and authority is hereby given to said company, * * * to construct, maintain and operate its various lines of railways, or any of them, or any part thereof, by electric power or by stationary engines not located on the public streets or public places on the streets, and propelled by other than animal power, and to connect its tracks with other street railroads."

A dispatch states that a Brooklyn jeweler proposes to emulate the example of Darius Green by constructing an improved flying machine. His power according to the dispatch will be furnished by a hundred pound electric motor.

THE TELEPHONE.

Since the recent decision rendered in the Bell telephone case by the United States supreme court, the Bell company in Joliet has commenced to raise the rates on telephones to subscribers, making a ruling that telephones used outside of certain limits must pay additional rent. Some of the stone companies, whose offices and quarries are located outside the city, will not stand the raise and have ordered their instruments removed.

The Spanish postal department have granted a concession for twenty years to install and work the telephonic service in the town of Felanita in the Balearic Isles.

The annual report of the American Bell Telephone company gives the following figures concerning exchanges in 1888; number of exchanges 743; branch offices 444; miles of wires on poles 127,902; miles of wire on buildings 9,458; miles underground 8,009; miles submarine 363; total number of miles of wire 145,732; total circuits 131,896; total employees 6,182.

THE TELEGRAPH.

A press despatch from Toronto announces that the government has prepared a bill fixing as the penalty for wilfully breaking a telegraph cable, imprisonment for five years.

The Western Union company experienced no little inconvenience in Chicago last week by the theft of a section of lead cable containing twenty wires which was to be used at a viaduct at Eighteenth and Grove streets. As a direct result all communication was cut off along the lines of the Wabash, the Grand Trunk, the Chicago & Eastern Illinois, the Chicago & Atlantic, the Santa Fe and the Chicago & Western Indiana railways. In some instances the train dispatchers were enabled to control the movements of trains, but on one or two roads the trains were run at great hazard. The loss will be nearly $1,000, the thieves can realize about $10 on their plunder. Two months ago the pipe was cut in the same manner.

W. E. Gump, general manager of the Writing Telegraph company, whose instrument was used experimentally in Rochester, said recently to a reporter in that city, "We now have a much better instrument than we had when we were exhibiting here, but we are exceedingly busy now putting them in fifty cities from Boston to Kansas City, to report ball games. We shall have our hands full of business in that line for sixty days. We are establishing exchanges in Pittsburg, Allegheny City, Little Rock and New Orleans. We have not given up Rochester yet and may come here again and show you our new instrument."

The largest telegraph business ever done in Berlin was transacted three weeks ago when 36,615 messages aggregating 1,115,551 words were sent to all parts of the world. During the busiest hours 346 operators were at work. London's highest day's record was in last June when 124,291 messages were handled.

The London *Electrician* says that the blizzard which demoralized the telegraph service in the eastern states in America has given addional arguments to the opponents of overhead wires. The paper continues: "The occasion is not one, however, for useless reproaches or ill-natured remark of any kind. Our American friends are face to face with a calamity which they have always known to be possible, and which the board of aldermen, of New York, have long been endeavoring to avert. Unhappily—and this is where the dilemma arises—notwithstanding the large sums already expended and the rigorous exercise of the powers at their command, the board have not been very successful in their attempts to solve the difficulty by placing the wires underground. The present disaster will no doubt lead to renewed efforts in this direction, and we still entertain a belief in their ultimate success. Meanwhile our American friends, while re-erecting their overhead lines, will no doubt follow the example set last winter, in this country, and take the opportunity to strengthen their supports, increase their struts and stays, and shorten their spans."

The legislative committee which is investigating the bribery cases at Columbus, O., summoned George Cole manager of the Western Union Telegraph company as a witness. He refused to furnish telegrams which had been sent through the Columbus office. This instance is interesting in connection with Dr. Green's testimony before the congressional committee in which he said he thought a law should be enacted defining the duties of telegraph companies in situations of this kind.

Judge Brady's affirmation of Judge Barrett's decision at New York, holding K. of L. boycott leaders guilty of offenses under the conspiracy statute, may be good law, but it is a two-edged sword. The offense of the men, whose writ of habeas corpus was dismissed, was that they had prevented a non-union shoemaker from obtaining work in any place after having driving him out of New York. This decision will give the Western Union Telegraph company considerable uneasiness, inasmuch as it has followed from place to place for many years, hundreds of its employes, whose names were on the black list, and prevented them from being employed. This constitutes conspiracy and every person who has suffered through treatment of this nature will now have recourse to law and an established precedent. It is to the credit of most of the Western Union officials that the black list is never consulted by them, and it is to the everlasting discredit of a very few that, although their authority covers small districts, their quota of names of victims is disgraceful and unmanly.—*Electric Age.*

At the annual meeting of the New York Telegraphers aid society in New York March 14th and 15th it was reported that the membership was 429. The receipts of the year had been $3,962.46 and there had been expended on account of sickness and death of members $1,815.15 The following officers were elected: President, Gardner Irving; vice-president, E. F. Cummings; secretary, J. M. Moffatt; treasurer, F. W. Baldwin; executive Committee, George W. Logan, John Brant, W. H. Jackson, H. I. Jolly, Miss K. E. Cummings, Mrs. Crans, T. T. Murphy; auditing committee, E. F. Stevens, D. C. Donohue and Edwin Dean.

Judge Barrett in New York last week dismissed the complaint in the suit brought by Townsend Cox against Edward S. Stokes, the United Lines Telegraph company, and the Bankers and Merchants' reorganization committee. He sought to have the sale of the Bankers and Merchants' to Stokes set aside.

Miscellaneous Notes.

A snake story, surpassing commonplace narratives of serpent adventures, comes from San Luis Potosi, Mexico. A domesticated rattlesnake 14 feet in length followed its master about like a dog. Recently many of the houses were struck

by lightning. The snake, seeing the bolts falling fast around the home of its infancy, determined to die for its benefactors, and forthwith climbed to the roof and in a perpendicular position standing on its head shook its rattles violently at the heavens, defying the lightning. The electricity attracted by this living lightning rod reduced to ashes the noble animal and the house.

Noted electrician—"I see you still have that old notion that a lightning rod is a protection." Nebraska farmer—"I have." "Now, sir, will you be kind enough to tell me what you think a lightning rod on your house protects you from?" "Lightning rod agents."—*Omaha World.*

It is said that in about three weeks the public will be given a chance to examine the graphophone or perfected phonograph. When 1,000 instruments are manufactured the business of the company which has them in charge will begin in earnest. The graphophones will be leased, not sold, and the annual rental will be, it is said, $60.

In a paper presented by Dr. A. C. Garratt, of Boston, it is stated that he has treated 186 tumors by outward electrolytic methods and 157 permanently disappeared.

The Electrical Institute of Vienna has begun a series of experiments to test the relative merits of the Julien, Reckenzaun and Scheneck-Farbaky accumulators.

Personal Paragraphs.

Professor John E. Davies, of the University of Wisconsin, at Madison, Wis., was a guest at the Chicago Electric club rooms Monday last.

Col. George L. Beetle has returned from a prolonged business trip in the east.

J. L. White of the Provident Savings bank in Kansas City, Mo., stopped in Chicago Monday on his way east, and was entertained at the Chicago Electric club rooms.

W. H. McKinlock of the Central Electric company has just returned from a flying trip through Nebraska and Iowa. He brought back with him several large orders for goods.

Professor F. B. Badt has resigned his position as superintendent of construction of the western department of the United States Electric Lighting company, Chicago.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	400
Central Union	47	48
Michigan	78	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	70	72

Business Mention.

Chas. A. Schieren & Co., of New York report recent sales of leather link belting, to the following concerns for use on dynamos: Utica Electric Light Co., Utica, N. Y.; Burlington Gas Light Co., Burlington, Vt.; United States Electric Light Co., Washington, D. C.

Electrical Patents.

Issued March 27, 1888.

379,944. Commutator for Dynamo Electric Machines. Thomas A. Edison, Llewellyn Park, N. J.

The machine supplies both continuous and alternating currents, a part of the former is used to energise the field magnet of the machine. We give the first and last claims: "1. The combination in a dynamo electric machine, of an armature having a continuously wound coil with two commutators on the shaft, each of which is directly connected with said coil, from one of which is derived a continuous current and from the other an alternating current, current collectors bearing on each of said commutators, and independent circuits extending therefrom.

"4. The combination in a dynamo electric machine, of an armature having a continuously wound coil, a commutator composed of blocks connected at intervals with said coil, two insulated rings on the armature shaft, and connections from opposite blocks of the commutator to said rings respectively."

379,956. Regulator for Dynamo Electric Machines, Chas. Heisler, St. Louis, Mo.

The second claim is appended: "In combination with the shaft driven constantly by the motor, eccentrics on said shaft, and levers carrying pawls adapted to act alternately on ratchet wheels on a shaft connected with the brushes, and a shoe acting on the extension of the index finger acting to control the pawls, the ratchet wheels and index finger and their supporting connections being also in the combination, whereby the said brushes are moved to regulate the current."

379,977. Electric Gas Burner. John Y. Parke, Philadelphia, Pa.

379,991. Submarine Torpedo Vessel. Charles D. Shepard, New York, N. Y.

380,010. Electric Annunciator. Charles S. Young and Gwynne E. Painter, Baltimore, Md.

380,020. Electro Dynamic Machine. George F. Card, Covington, Ky.

380,022. Non-Interfering Signal Box. Frederick W. Cole, Newton, Mass.

380,053. Machine for Dressing Covered Electrical Conductors. William H. Sawyer, Providence, R. I.

380,054. Apparatus for Threading Wires or Cords Through Flexible Tubes. William H. Sawyer, Providence, R. I.

The first claim is given: "In an apparatus for threading wires through flexible tubes, an upper and lower guide arranged to give a vertical position to a traveling flexible tube, a weight for holding the wire stationary in said vertical portion of the tube, and a vertical guide surrounding said tube."

380,060. Electric Railway. Francis M. Speed, San Francisco, Cal.

380,074. Arc Lamp. Thomas E. Adams, Cleveland, Ohio.

We give claim 1 and 2: "1. In an arc lamp, the combination, with a gravity feeding carbon and a clutch adapted to normally clamp and support the same when no current traverses the lamp, of two electro-magnets or solenoids, one for actuating the clutch and releasing the carbon to the action of gravity and the other to actuate the clutch to clamp and raise the carbon and establish the arc.

"2. In an arc lamp, the combination, with a gravity feeding carbon and a clutch constructed to normally clamp and support the feeding carbon when no current traverses the lamp, of an electro-magnet for raising one side of the clutch and releasing its grip on the carbon, and an electro-magnet or solenoid for raising the opposite side of the clutch and clamping and raising the carbon."

380,084. Galvanic Battery. Horatio J. Brewer, New York, N. Y.

380,100. Pyromagnetic Motor. Thomas A. Edison, Llewellyn Park, N. J.

The invention is based upon the principle that the capacity of iron for magnetism diminishes as its temperature is raised and that at a bright red that it becomes practically diamagnetic. Advantage is taken of this fact to construct an apparatus in which motion is produced by the combined action of heat and magnetism.

Claims 4, 5 and 7 read as follow: "4. A prime motor having, in combination, a revolving interstitial magnetic body, a magnetic field in which said body is located, and means for heating opposite parts of said revolving magnetic body to produce an unbalanced condition of the same.

"5. A prime motor having, in combination, a revolving interstitial magnetic body, a magnetic field in which said body is located, means for heating opposite parts of said revolving magnetic body to produce an unbalanced condition of the same, and means for cooling the intermediate parts of said body.

"7. A prime motor having, in combination, a magnetic body, a magnetic field produced by an electro magnet, means for heating said body to produce an unbalanced condition thereof, and a dynamo electric machine driven by the movement of said magnetic body and supplying current for energizing said field magnet."

380,101. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.

Claim 7 reads: "7. In a system of electrical distribution, the combination of two or more sections of main conductors, each of one or more divisions, sub-feeders of low resistance for each section, a main feeder for each section extending from the sub-feeders back to the station, a conductor connecting the sections in series, compensating conductors for the divisions of the system, pressure indicators showing the pressure at the outer end of each main feeder, and a dynamo electric machine for each division of the system provided with means for its independent regulation."

380,102. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.

We give the last claim: "In a system of electrical distribution, the combination, with two or more feeders having means for varying the pressure at their outer ends, and a set of pressure wires extending from the outer end of each feeder back to the station, of a double wound electrically moved indicator for each set of pressure wires and connected by one winding with such pressure wires, and a standard battery connected with the other windings of the two or more indicators and opposing at such indicators the energy of the system."

380,103. Conduit for Electrical Railways. Stephen D. Field, Yonkers, N. Y.

380,114. Incandescent Electric Lamp, Holder and Cut-out. Charles Heisler, St. Louis, Mo.

380,115. Alternating Current Dynamo Electric Machine. Charles Heisler, St. Louis Mo.

The invention includes a s ationary armature, revolving field magnets, and an exciting generator for the field magnets, supplying a continuous current thereto, the stationary armature being composed of sections wound to produce alternating currents adapted to furnish the working circuits without the use of a commutator.

The first and fifth claims are given: "1. In a dynamo electric machine, an armature composed of insulated sections and wound with coils forming a circuit, of which coils a pair is placed on each section, and the coils of the circuit alternate in direction of winding."

"5. In a dynamo electric machine, a stationary armature made up of core segments, each segment consisting of curved pieces of sheet metal with coils wound thereon, the coils being divided by angular pieces set into the segments, but insulated from the metal thereof, the said angular pieces projecting above and below the segments."

380,144. Dynamo Electric Machinery. Frank J. Sprague, New York, N. Y. We give the first two claims:

"1. The combination, with a shaft having upon it two opposite screw threads, of an armature core thereon composed of thin metal plates, and clamping end plates having screw threads corresponding respectively, with those on the shaft, between which the thin plates are compressed and held closely together.

"2. The combination, with a shaft having upon it two opposite screw threads meeting at the middle point of the shaft, of an armature core thereon composed of thin metal plates, and clamping end plates provided with hubs having internal screw threads corresponding, respectively, to those on the shaft, said end plates being screwed upon the shaft so that said thin plates are compressed and held closely together between them."

380,157. Electric Conductor. Edward G. Acheson, Pittsburgh, Pa.

The invention consists in an electric conductor composed of a central conductor covered with insulating material, upon which is applied a covering consisting of a strip extending spirally around the same, and having spirally-formed spaces or recesses between the adjacent edges, whereby the conductor may be more easily bent or twisted.

380,158. Manufacture of Electric Conductors. Edward G. Acheson and Benjamin F. Anderson, Pittsburgh, Pa. We give claim 2:

"2. In the manufacture of electrical conductors, the method, substantially, as herein set forth, of forming a covering with spiral grooves therein, consisting in winding a thread spirally around the insulated conductor and electrolytically depositing a covering on conductor."

380,165. Railway Signal. Arthur W. Bennett and John M. Millen, Fontanelle, Iowa.

380,202. Incandescent Electric Lamp Holder and Cut-out. Charles Heisler. St. Louis, Mo.

Claims 1 and 2 are given—"1. In combination with an electric lamp and an electro-magnetic shunting mechanism, the core of which is directly connected to one of the lamp terminals and forms a part of the circuit between that terminal and one of the line wires, and having its coil in a circuit around the lamp, a switch operated by the electro-magnet and arranged to short circuit the lamp.

"2. In combination with an electric lamp, a magnet core, the coils of which are in shunt with the lamp circuit, and having flanges on its ends acting as pole pieces, the flange at one end being connected permanently to one of the lamp terminals, the flange at the other end connected to binding posts, one insulated and the other uninsulated thereon, connections between the insulated post and the other lamp terminal, whereby the lamp circuit is formed through the core, and a magnetic shunt operated by the armature of the electro-magnet when the lamp fails to work."

380,215. Ear Battery for the Deaf. Mary E. Moore, New York, N. Y.

380,241. Fire and Burglar Alarm System. William A. Barnes, Bridgeport, Conn.

We give claim 3: "The combination, in a fire or burglar alarm system, of a source of electricity, a main line, a shunt circuit including two branch conductors in multiple arc connected at both terminals to said main line, an electro-magnet having two oppositely wound coils in the respective circuits of said branch conductors, an armature in the field of said magnet, and three circuit closers controlled by said armature when actuated by said magnet, one of said circuits closers making and breaking circuit through main line between the shunt terminals, and the other two circuit closers respectively making and breaking circuit at each point of connection of said shunt terminals with main line."

380,261. Electric Vapor Bath. Robert F. Johnson and William R. Pope, Baltimore, Md.

380,271. Electric Arc Lamp. Charles W. Adams, Chelsea, Mass.

380,295. Insulated Electrical Conductor. William A. Phillips, Schenectady, N. Y.

The claims are given: "1. The combination, with an electrical conductor, of an insulating covering consisting of a sheet or strip of rubber impregnated with paraffine or similar moisture proof substance wrapped on said conductor.

"2. The combination, with an electrical conductor, of an insulating covering consisting of a sheet or strip of rubber impregnated with paraffine or similar moisture proof substance wrapped on said conductor, and an external fabric covering.

"3. As an insulating material for electrical conductors, sheets or strips of vulcanized rubber impregnated with paraffine or similar moisture proof material."

380,301. Electric Light and Globe Protector. William M. Tompkins, Batavia, N. Y.

Reissue. 10,915. Telephone Transmitter. John H. Irwin, Morton, Pa.

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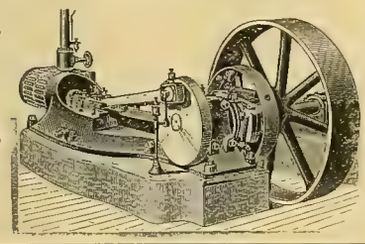

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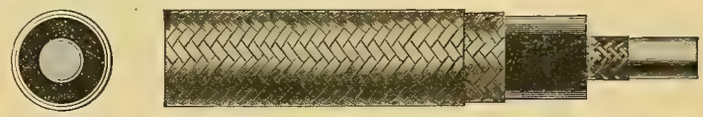

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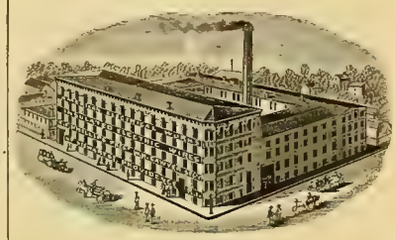

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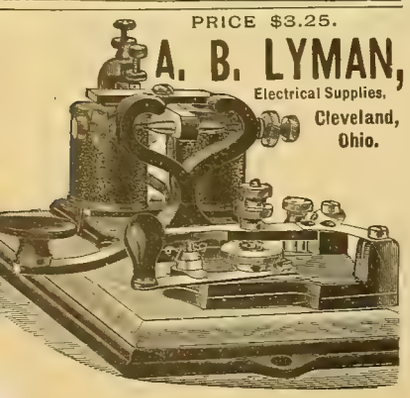

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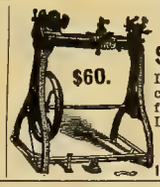

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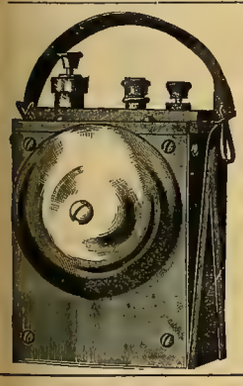

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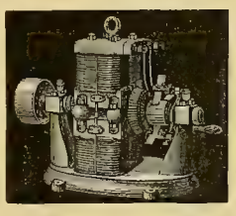

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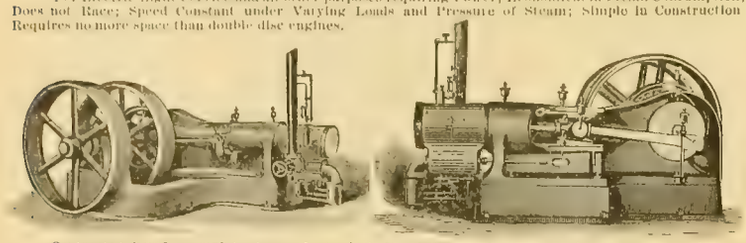

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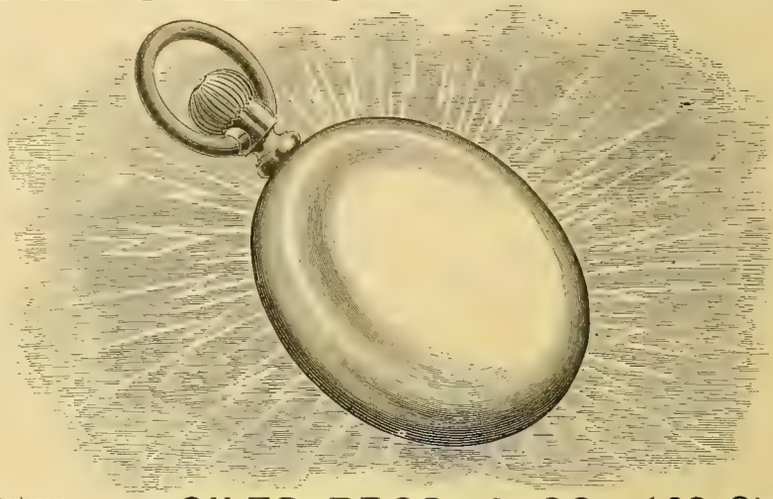
Gentlemen: — Your Anti-Magnetic Shield for watches cannot be over-estimated. It is now very near eight months that I have worn my watch, and to-day it is (without correcting time) about one minute slow. Considering the fact that I am every day near dynamo electric machines in our regular business, the test could not be harder. I could never have believed it before that protection was so complete. In this age of electricity, not only electricians, but everyone who needs the correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good timekeeper. At present, I look upon a watch without a shield as a thing incomplete, and so it is. Very Respectfully,

CHAS. J. VAN DEPOELE,
Electrician, V. D. P. E. M. Co.



"——* * * I have no hesitation in saying that I believe the shield would perfectly protect the watch against any magnetic influence to which it is likely to be exposed by being worn in the vicinity of a dynamo machine.

The plan you have adopted of placing the watch movement inside a closed box of this magnetic material, is based on true scientific principles, and is the only plan I know that could succeed.

WM. A. ANTHONY,
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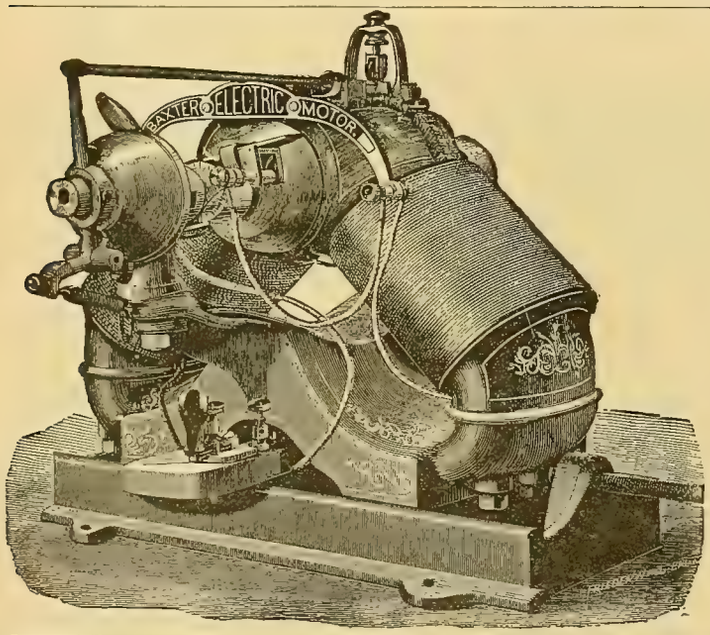

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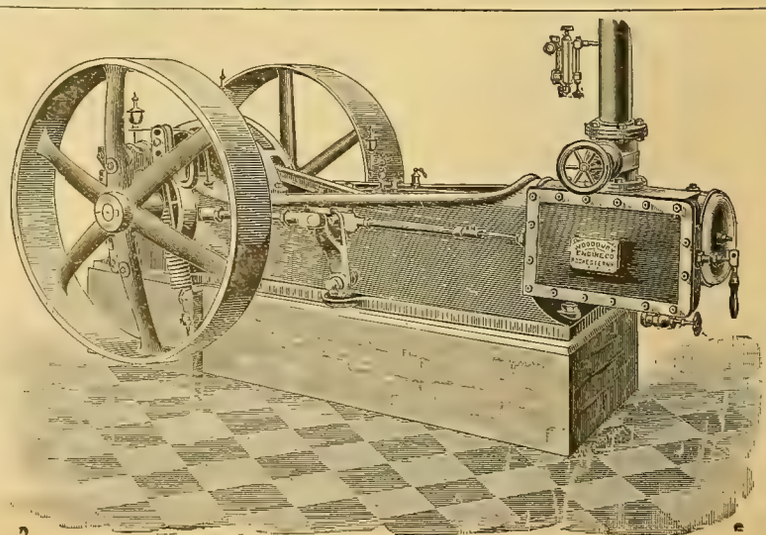

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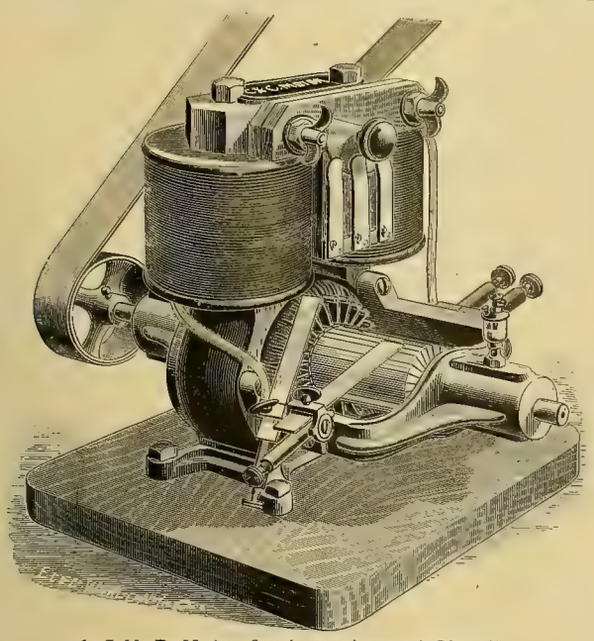

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BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

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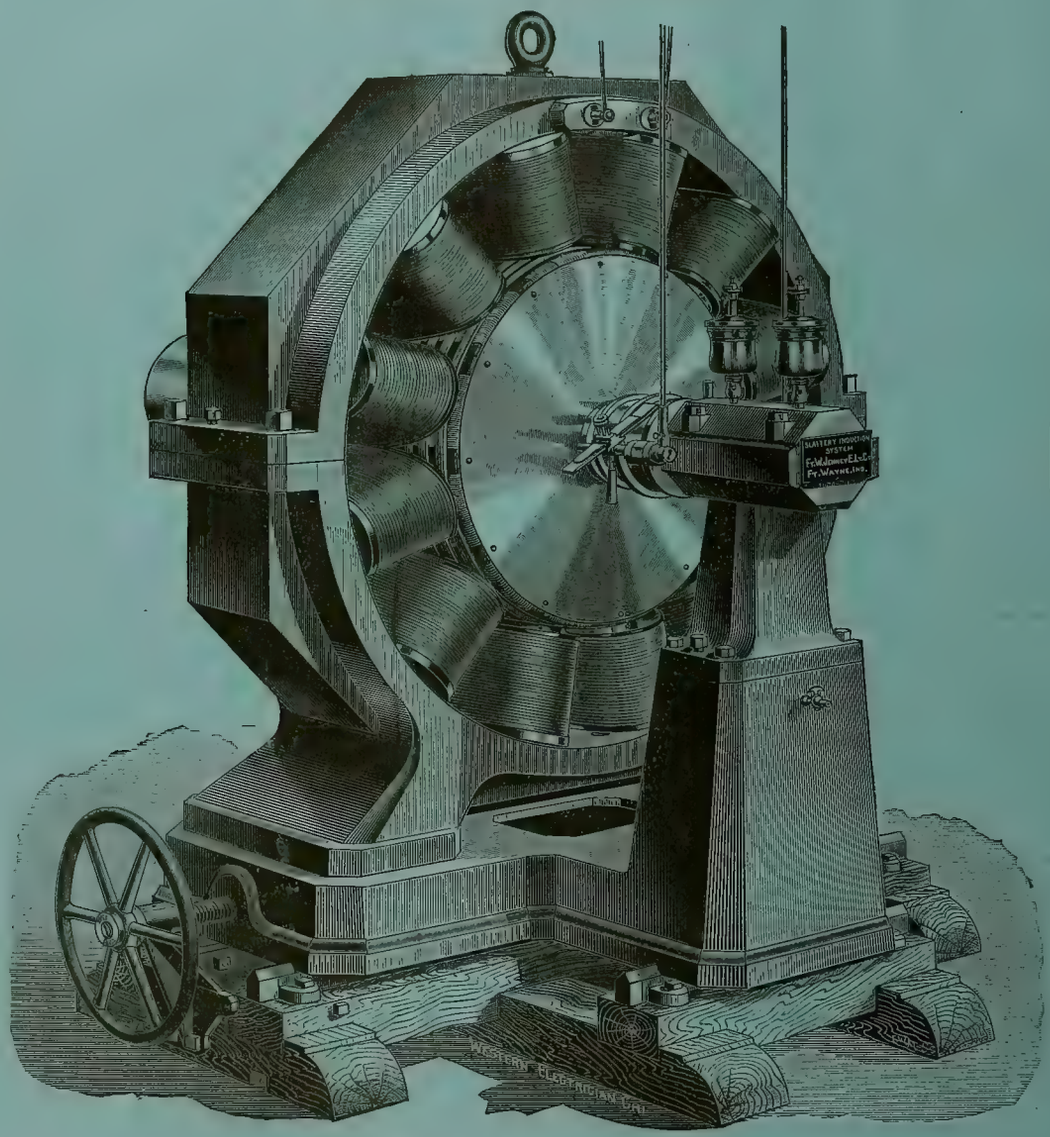

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16

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Vol. II. CHICAGO, APRIL 14, 1888. No. 15.

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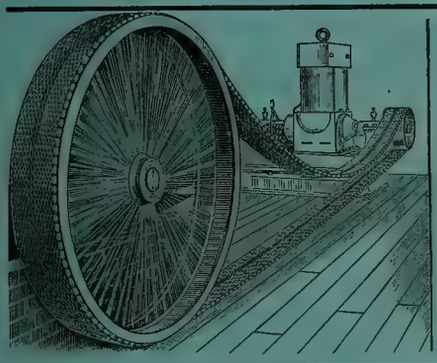

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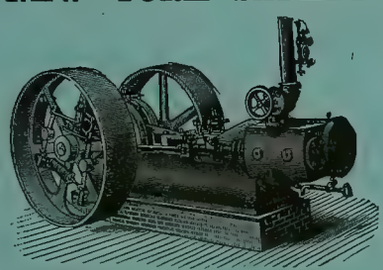

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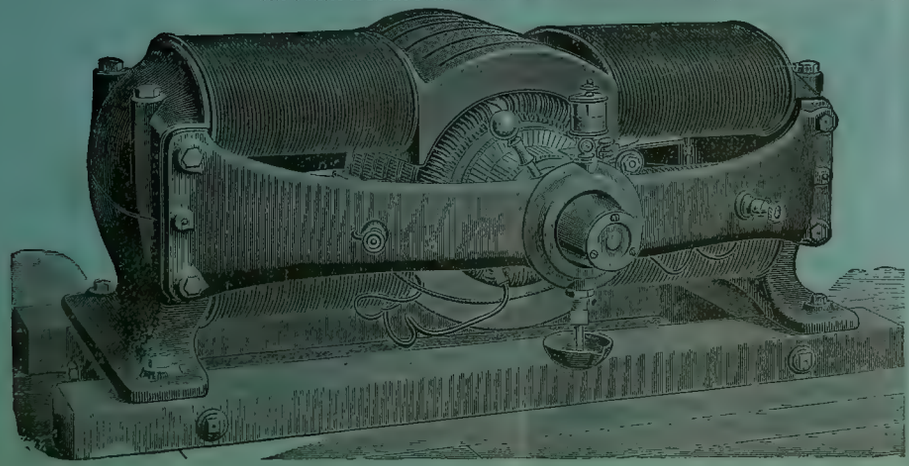

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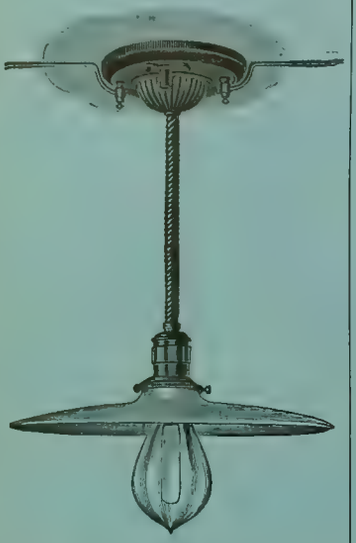

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Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

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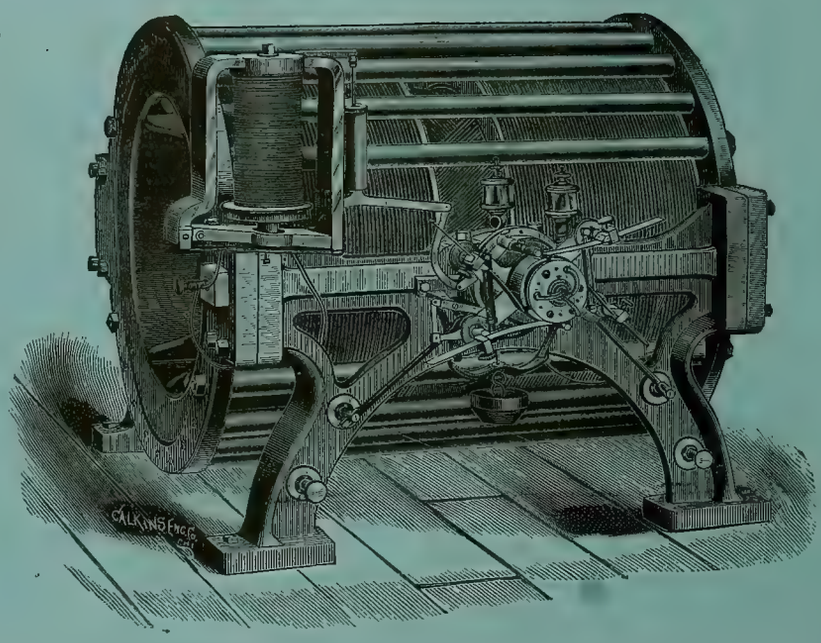

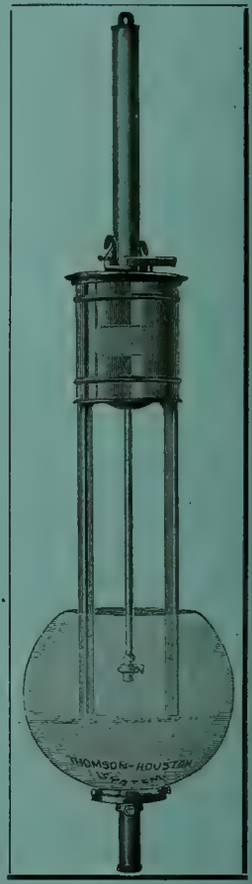

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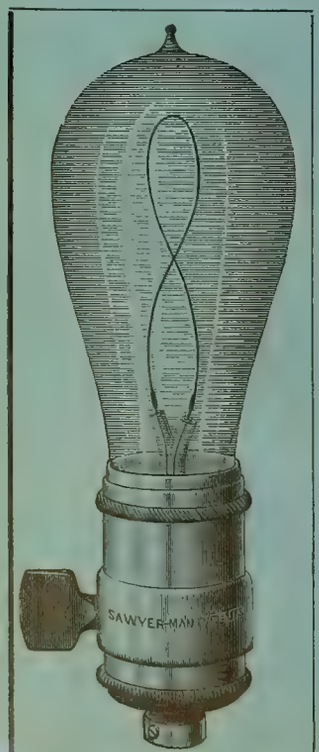

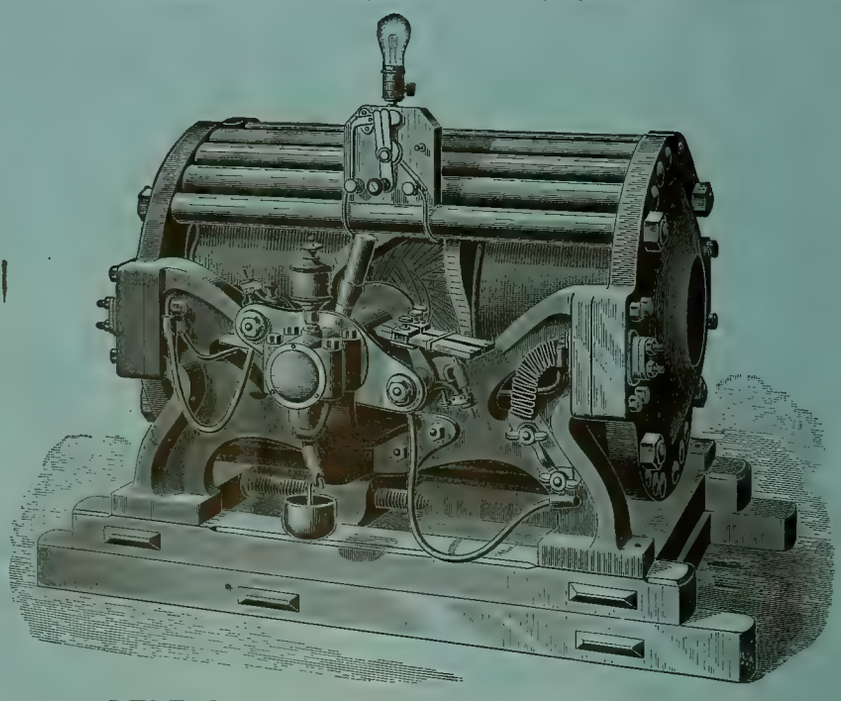

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RESULT OF

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610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

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AND UNITED STATES PUT IN.

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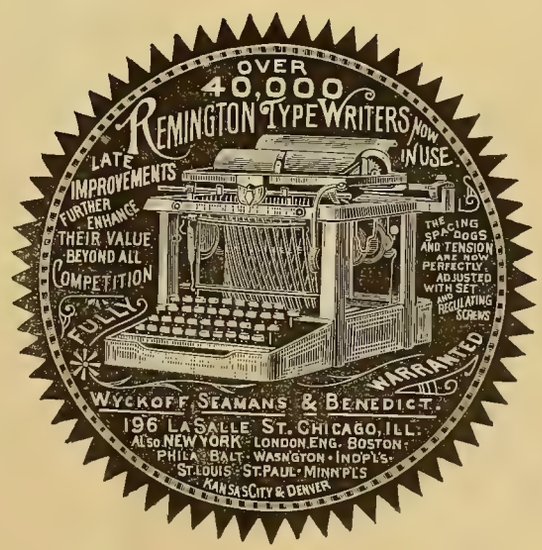

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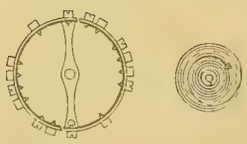
WHICH ARE

Uninfluenced BY **Magnetism.**



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Adjusted TO **Temperature.**

These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

For Sale by all First-class Jewelers.

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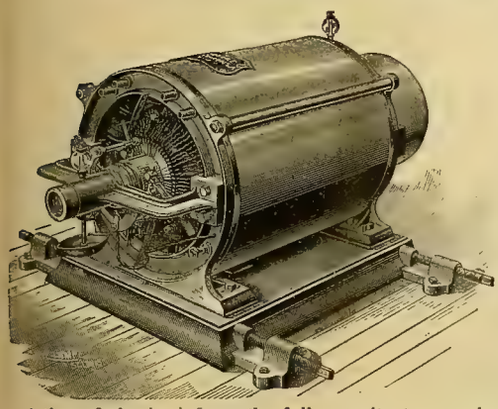
The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

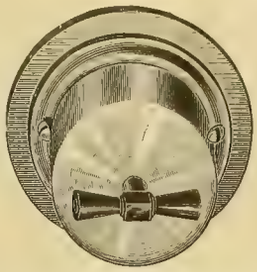
We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

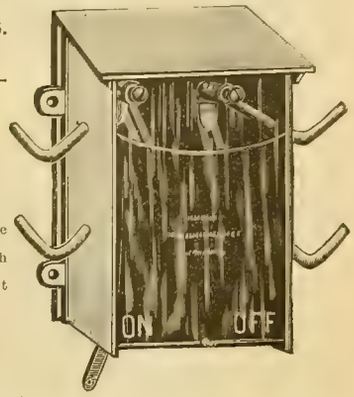
Forest City Electric Works,

Manufacturers of CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.





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W. B. CLEVELAND Proprietor, 26 S. WATER STREET, CLEVELAND, O.

Our BELTING is tanned on the surfaces only; the **INTERIOR is RAW HIDE.**

Send for Our Valuable Book for Engineers and Belt Users. Free.

Agents in all Cities. Send for Trial Belt.

Our Belts are the strongest, most even and perfect Electric Belts made.

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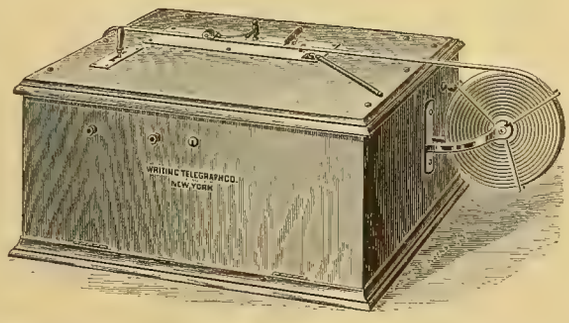
WRITING TELEGRAPH COMPANY,

57 Murray Street, New York.

This Company owns the Letters Patent which thoroughly control the transmission of written messages by telegraph in the only known practical way, and are prepared to establish Central Office Exchanges as a means of communication between subscribers in cities and surrounding towns.

Communications are written with pen and ink in the handwriting of the person writing the message.



The pen in the office of the subscriber receiving a message makes a fac-simile of every letter as fast as it is made with the pen in the office of the person writing it.

All instruments are under the control of the Central Office, and messages are recorded on the instrument of a subscriber, whether he is present or absent.

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Begs leave to announce that it has largely increased the quantity and surface and greatly improved the form of the negative element of the

LAW BATTERY.

The New Form is clearly shown in the cuts and needs no explanation.

ITS ADVANTAGES.

The Battery holds up longer when overworked, recovers quicker when relieved, and the material being all in one piece instead of in two pieces, the breakage heretofore suffered in transportation, in handling, and in any depolarizing treatment (after accidental short circuiting) will be wholly saved. *"It was good before; it is better now."* The Battery *otherwise* is unchanged. **The negative element** is of the same material and undergoes the same preparation as before, and is *everlasting*, and so guaranteed.

THE OTHER FEATURES OF SUPERIORITY, NAMELY:

Connections that will not corrode, Lock-tops that absolutely prevent evaporation and creeping of salts, absence of grease, Flint Glass well annealed, Hard Rubber Bolt connection that is reliable and durable, pure Zinc and pure Sal Ammoniac, etc,

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MANCHESTER, CONN.

H. G. CHENEY, Pres. M. S. CHAPMAN, Vice-Pres. ROBERT CHENEY, Sec. and Treas. N. T. PULSIFER, Gen'l Mang'r.
WM. A. ANTHONY, Consulting Electrician.

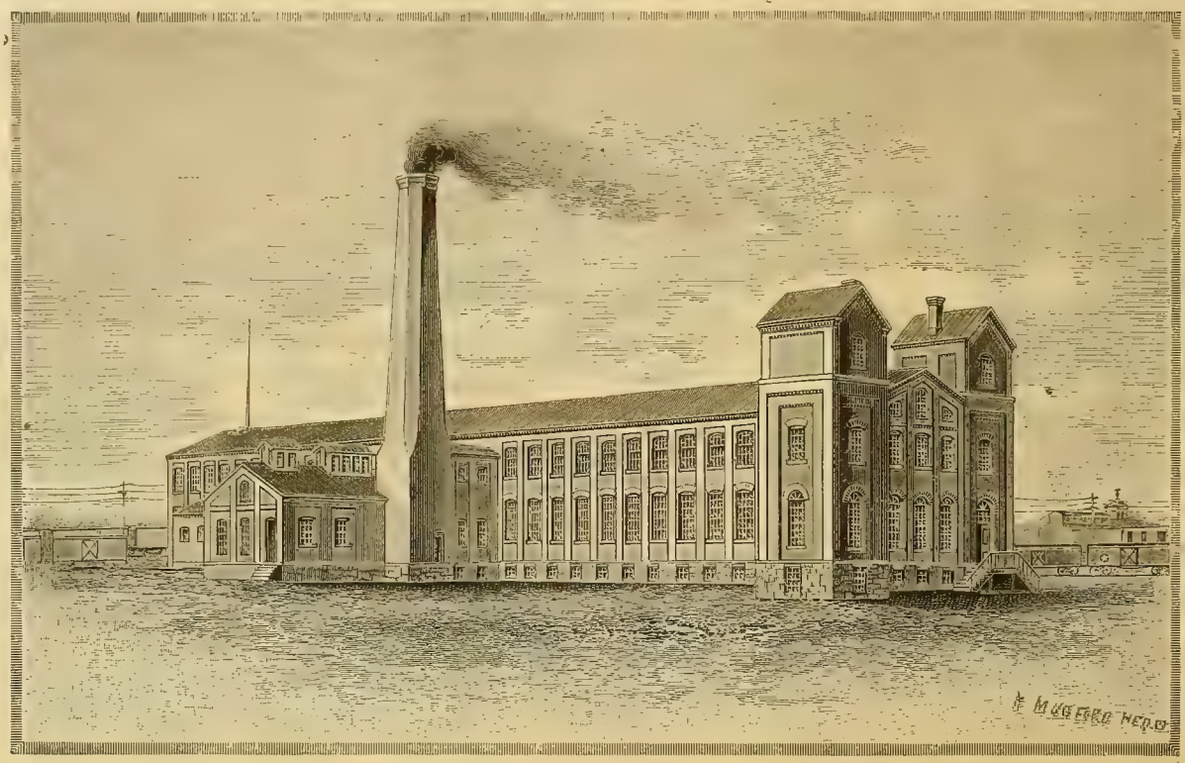
New York Office, 35 Broadway. Chicago Office, 38 LaSalle St. Boston Office, 143 Federal St. Cincinnati Office, Carlisle Building.

INSTRUMENTS

—OF—

PRECISION.

We make instruments for Electrical Measurements, adjusted to any degree of precision required for any purpose. Resistance boxes are made with any required series of resistances, with and without proportional coils for bridge. All resistances are adjusted to legal ohms by standards tested at the Cavendish Laboratory and certified by the British Association Committee.

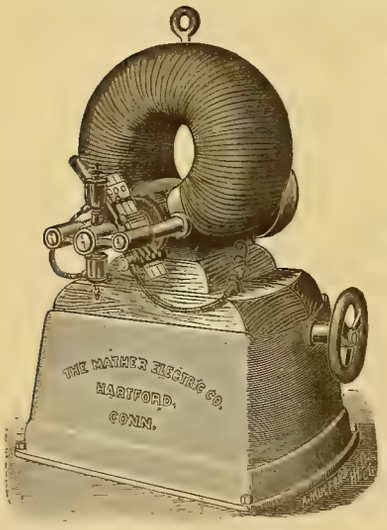


—IN—

RESISTANCE BOXES

required for physical research, all the coils will be made from one piece of wire, to insure a uniform temperature coefficient. Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order. Ammeters, Voltmeters and Resistance Coils will be calibrated, and constants furnished.

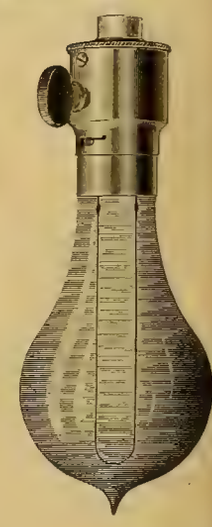
The Mather System for Incandescent Lighting.



The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.



MOTORS.

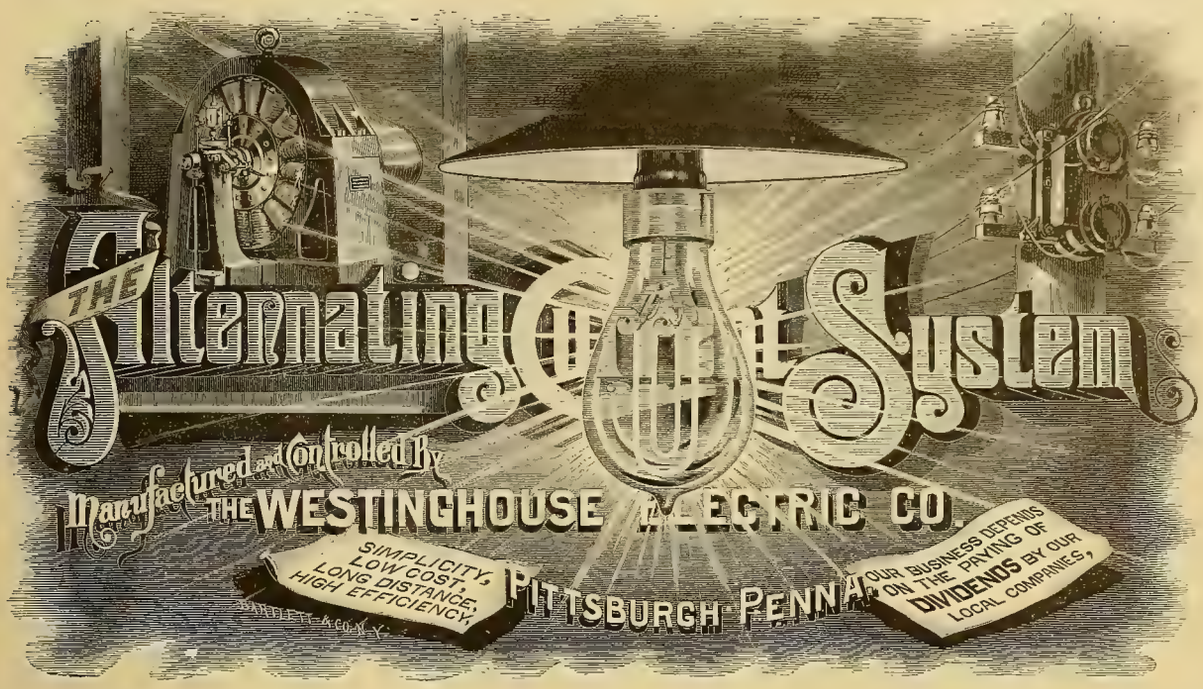
We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuits.

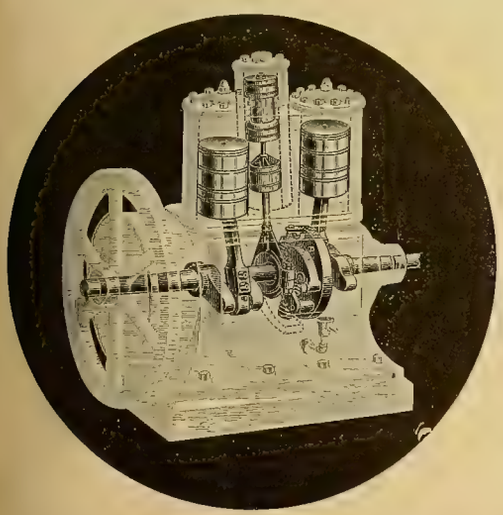
Chicago Office, 38 La Salle Street.

The Tucker Electrical Manufacturing Co.,

35 Broadway, New York City.

Selling Agents of the MATHER ELECTRIC COMPANY for the States of New York, New Jersey and Pennsylvania.





The Single-Acting and Self-Lubricating Principles

Mark the second great advance in Steam Engineering, and represent the Highest type of

COMMERCIAL ECONOMY.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

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Represented by ROBERTO BOKER & Co, City of Mexico, Mex.

Stevens, Corwin & Co., 118 Chambers St., New York City.
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The Railway Telegraph Supply Co.

211 AND 213 RANDOLPH ST., CHICAGO,

Manufacturers of and Dealers in

ELECTRICAL APPARATUS AND SUPPLIES,

ANNUNCIATORS, MAGNETO BELLS, BATTERIES, ETC.

WE CARRY A FULL STOCK OF J. H. BUNNELL & CO.'S TELEGRAPH INSTRUMENTS.

Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

WESTERN ELECTRIC COMPANY,

Chicago. London.

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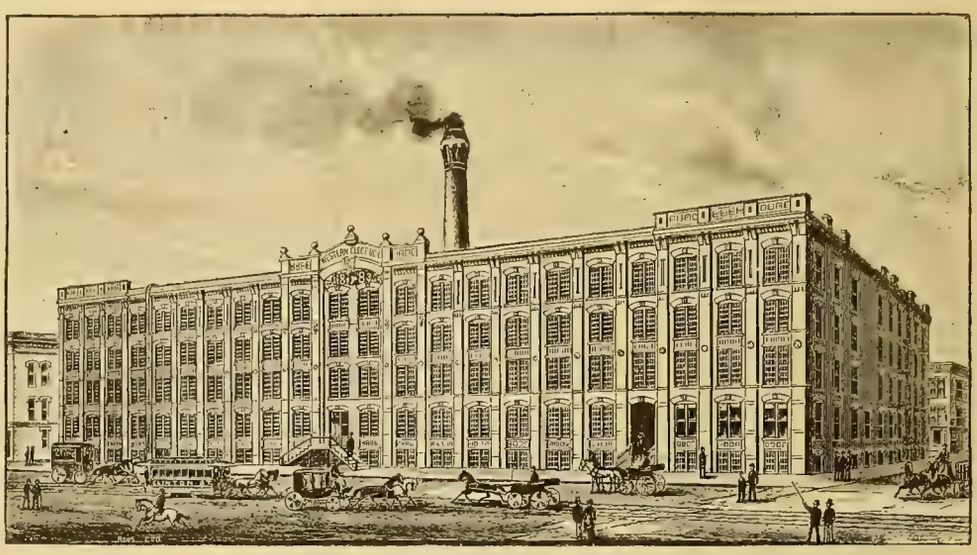


CHICAGO FACTORY.

Disque LeClanche Battery.

Western Electric Co., Chicago, Ill., April 10, 1888.
Chicago, Ill.

Gentlemen: Replying to your inquiry of this date, I would say, I have kept a record of the service we get from many of the Disque LeClanche porous cups furnished the Chicago Telephone Company by you since September, 1884. Without going into the minutes of this record I will state that it shows that we have had batteries in use which have been in CONSTANT SERVICE for about THREE YEARS and EIGHT MONTHS, and that the AVERAGE SERVICE which we get from porous cups of your manufacture is OVER ONE YEAR and SIX MONTHS.

Our inspectors are instructed to replace porous cups as soon as they show signs of failure, and many of the porous cups brought in as having been used up are still in fairly good condition and would give good service in places which do not require the work from a battery which telephone service requires.

Yours very truly,

J. J. NATE,

Purchasing Agent Chicago Telephone Co.

Western Electrician.

EVERY SATURDAY

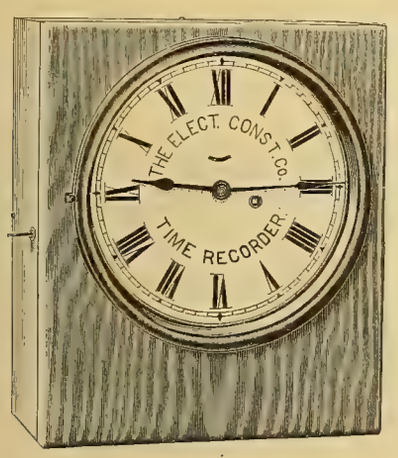
Vol. II. CHICAGO, APRIL 14, 1888. No. 15.

New Time Recorder.

The utility of a reliable watchman's time recorder is everywhere recognized. Property owners demand a contrivance which will indicate with absolute certainty whether watchmen are performing the duties which they are paid to perform. The accompanying cut shows a new time recorder manufactured by the Electrical Construction company of Chicago.

Each station is connected with one of the solenoids under the cylinder. On closing the circuit through a relay, a second circuit is closed through the solenoid, and the pointed core makes a depression on the paper. As the cylinder revolves with the clock, the sheet on the cylinder shows at what hour the impression was made, and also, at what station.

The clock also makes a useful piece of office furniture. The company make a five station clock for stores, in which one station is the clock door itself, so that, even if the lock of the clock is picked, a record will be left of it. Another station is connected with the front door, another with the rear door by door springs, and still another is connected with the outside of the building for the watchman or patrolman along the street to use. A number of these recorders



have been put up and are giving excellent satisfaction.

Chicago Elevated Road.

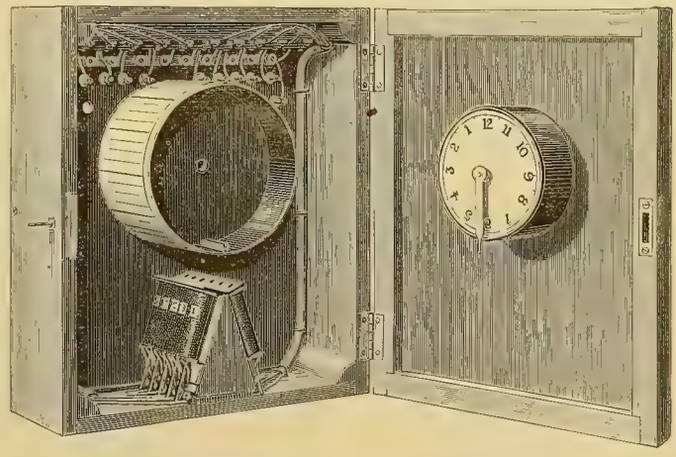
The text of the ordinance presented to the city council of Chicago, providing for the construction of an elevated railroad on Lake street contains this provision. "The Lake street elevated railway company of Chicago is hereby authorized to construct and operate by steam or electricity an elevated railway on and along Lake street in said City of Chicago, commencing on the east side of Canal street in said city and running thence west on said Lake street to the western city limits. Said construction of said railway to be of double track at a clear elevation of fourteen feet above the surface grade as established by the city of Chicago, and to be constructed according to the plans and specifications of the Meigs system of elevated railways." Permission is given the company to construct "telegraph and telephone signals, and all other requisite and convenient appliances upon said route as shall be required for the convenience and safe and rapid operation of said railway The said telegraph and telephone lines shall be attached to the structure of said railway and be a part thereof and be used only for the transaction of the business of the said railway company."

The Chicago Cushman Telephone Company.

The common council of Chicago granted a franchise to the Cushman Telephone company at the meeting April 5th. The ordinance as amended provides that the company may construct and maintain in the streets, alleys, and tunnels wires and electrical conductors for telephone service. Between Chicago avenue on the north, Ashland avenue on the west, and Twenty-second on the south the wires shall be underground. Outside this district poles may be erected and the wires put on buildings with the consent of the owners. The commissioners of public works and the fire marshal will determine the size and height of the poles to be used. Within four years all poles within the district bounded by North avenue, Western avenue, Twenty-second street, the South Branch and Thirty-first street shall be removed and the wires put under ground. Within the city limits as they existed July 1, 1887, the wires are to be put under ground in six years. The surface of a street or alley is not to be disturbed without the consent of the commissioner of public works, and the sum of $500 shall be deposited as a guarantee that such street or alley shall be restored to a condition satisfactory to the commissioner of public works. The prices are to be $95 for the first year and $85 for each succeeding year, except where a contract is made for three years, when the rental per annum shall be $75. The public offices are to be supplied with telephones free of charge, and telephones for police and fire alarm systems shall be rented to the city for not more than $5 per annum. A bond for $10,000 must be given by the company for the payment of all damages that may accrue. The franchise will expire within twenty years.

Central Station Lighting by Storage Batteries.

There are now installed two boilers and two direct acting steam dynamos, of the Willans-Crompton type, in Mr. Crompton's central station at Kensington Court, says *Industries*. One of the dynamos is a double horse shoe horizontal machine, and the other is of the inverted single horse shoe type. Each machine is able to supply current equal to from 40 to 45 horse power, but only one machine is at present required at a time. At one end of the machine room there are stages for several batteries of storage cells; but only one battery is at present in use, and is connected by means of an ingenious switch-board with three lighting circuits, all of which have a very low resistance, so that the loss of pressure in the mains is only trifling. At present the routine of the installation is as follows: One of the engines is started about three o'clock in the afternoon, and begins charging the battery. At the same time the current is sent out from the battery to the various lighting circuits, and these connections are never interrupted during the whole twenty-four hours, so that consumers can have the light at any moment of the day or night. The consumption reaches a maximum towards seven o'clock in the evening, and by about eleven o'clock it has again sufficiently declined to allow of the engine being stopped. Meanwhile the batteries have received a sufficient charge to last till the next afternoon. After stopping the engines at eleven o'clock, the station is locked up left to itself. The charging current and the discharging current are both measured by Aaron's coulomb meter, and in the consumers' houses there are installed either Ferranti or Cauderay meters. The mains in the street are of a novel construction, and consist of bare copper strips supported on porcelain insulators, within a brick culvert set in cement. At certain intervals a flag of the footpath is provided with lifting rings, so that it may be lifted to give access to the mains. The house connections are simply soldered to the copper strips, the switch and fuse being placed, not in the culvert, but at the entrance to the consumer's premises. Each main is protected by fuses at the station, and potential wires are carried back from the far end of the main to the station, to indicate the pressure at the lamps. The attendant is therefore enabled to regulate, by means of the switch-board, the number of cells working on any particular circuit, so as to maintain the the pressure constant within one or two volts.

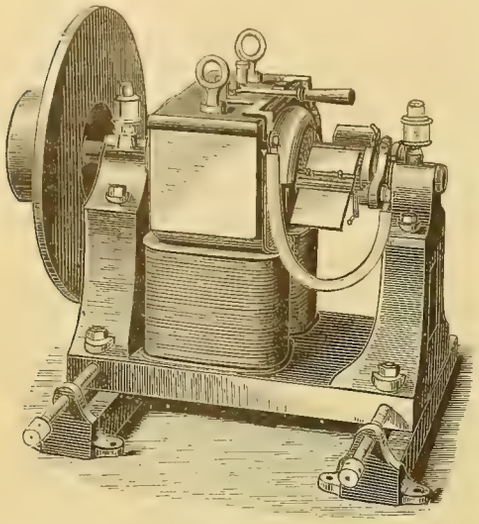


Death of G. W. Sutton.

G. W. Sutton, an electrician in the employ of the Western Electric company of Chicago, fell down an elevator shaft at the company's works Tuesday, and was instantly killed. He was 22 years of age and unmarried. His parents reside in Philadelphia.

Fowler, Lancaster & Co.'s Dynamos.[1]

We illustrate herewith a dynamo of the Kapp type, constructed by Fowler, Lancaster & Co., of Birmingham. The illustration is taken from a photograph of a 3-unit machine, intended to run at 1,000 revolutions per minute, and giving 63 volts with 53 amperes. The field magnets and pole pieces are forged in one piece of best Swedish iron, planed and shaped. The pole pieces are polished and varnished. The commutator is phosphor bronze, and has 48 sections, with 4 turns of wire in one layer connected to



each section. The armature is of the ring type; its core is built up of charcoal iron disks, number 22 wire gauge thickness. The diameter is 8¼ inches, and resistance .058 ohms, the resistance of the field being 18 ohms. The brushes are made of strip copper, the inside strips being slit, but not those outside. The machine runs quite cool, and without sparking at the brushes

Alternate Current Transformers.

English electrical journals publish the following letter from Edward Manville, on the subject of alternate current transformers: "I notice in your late issues a series of reports of the discussion on the above subject, at the Society of Telegraph Engineers and Electricians, which took place during my absence in America. Both Mr. Gordon and Mr. Crompton seem to be extremely doubtful of the possibilities of an alternating system, assuming certain details of working on which the efficiency of the system must depend to be impracticable. I allude to the coupling up of alternating machines in parallel and the use of small machines instead of large ones. My company having interests in this system of distribution of electricity, I inspected several stations in the states equipped with complete Westinghouse plant, the power being transmitted through a belt. They would have in the daytime a sufficient number of machines running to just supply the required current thus obtaining a maximum efficiency of both engine and dynamo, and as the demand for current increases more machines are connected in parallel to the working system. The method of connecting in parallel has been brought to a simplicity that leaves nothing to be desired. The already working system and the fresh dynamo that is to be added to it, are connected to two circuits on a small piece of apparatus, showing by two lamps the difference of phase of the two currents. Each lamp varies from a maximum brilliancy to 'black out,' at a comparatively slow rate, and not coincidentally. The 'beats' of the lamp alter in respect to each other until in a few seconds the lamps go out and attain their maximum brilliancy at the same time. When this point is reached the switch is put up, and the machines are running in parallel without any disturbance taking place. Looking at the machine that is about to be switched on, the only evident sign at the moment of connection is a tightening of the belt from the load placed on it. One is bound to conclude, therefore, that 'the bottom has been knocked out' of many of the arguments used in the course of the discussions above referred to, and that the consensus of opinion in this country in favor of distribution by means of transformers is fully justified and strengthened by what is being achieved daily in America."

[1] London *Electrician*, March 23d.

The Pentane Standard Lamp.

A new phometric lamp, devised by A. V. Harcourt, was recently exhibited before the physical section of the British association. This lamp burns pentane vapor only, has no glass chimney around the flame and yet burns steadily even in moderate draughts, at the same time fulfilling the important condition that the color of the flame should be as white as possible. The construction is substantially as follows: An ordinary lamp bowl mounted on leveling screws contains the pentane; this is surmounted by a vertical metal tube several inches in length, open at both ends, and jacketed by a larger tube to which it is attached, there being an air space between the two; these two tubes are inclosed in an outer jacket, the diameter of which is reduced at the top to correspond to that of a metal chimney supported at some distance above it, leaving an open space for the flame between them. The inner tube contains a wick which terminates about three inches below the flame, which is at the top of the outer jacket, and consequently entirely clear of the wick. The jackets are designed to inclose the pentane vapor and sustain constancy of temperature. The metal chimney has the same diameter at its lower end for about one fourth of its length as the top of the outer jacket, and is enlarged for the remainder of its length. Its office is to produce draught without inclosing the flame as a glass chimney does. It is attached to the outer jacket by two supports with thumb screws in such manner that it can be raised or lowered to any required distance. The lower outer jacket tube is so attached as to be easily removable, and the lamp is put in operation by removing it, warming the inner tubes and lighting the pentane gas thus generated. The outer jacket with chimney attached being replaced the flame rises through and above the narrow part, its top entering the chimney when the wick is slightly raised. By means of two slots on opposite sides of the chimney the tip of the flame can be inspected and its height regulated to give a definite quantity of light. The light emitted from the center of a flame being but slightly affected by considerable variations in its height, it has been found experimentally with this lamp in what part the brightness is most constant, and what variations in height of flame are required to sustain this constancy. By varying the distance between the chimney and lower tube, as well as the height of the flame, the light can be regulated to a candle, half candle, or a candle and a half, or any intermediate value as required. Gauges giving the required heights for these different candle powers are fitted to the space between the tubes.

Chicago River Lighting Plant.

Professor J. P. Barrett, city electrician of Chicago, has long been an earnest advocate of not only lighting Chicago streets by electricity but of the city's owning and maintaining the plant, or plants, for that purpose. Less than a year ago, the electrician succeeded in securing an appropriation for the establishment of a plant to light the river bridges and approaches. Last December, the plant was started with a few lights and during the winter the circuits have been gradually completed and lights put up until now there are about 103 lights burning. The cost of the plant was about $30,000 and it has been so warmly approved by city officials that another appropriation of $30,000 has been made to extend the system. The electrician is much gratified in that his efforts to improve even a small portion of the lighting of the city have been so successful and so cordially commended by the public and believes that the time is not far distant when the city, or at least the business portion of it, will be lighted by the modern light — the arc lamp.

The explanation of reasons why the river was chosen as the place for the first electric light plant to be owned by the city involves a reference to the city's geography, familiar enough to residents. The city is divided by the Chicago river into three divisions, the north, south and west sides; the first including that portion bounded on the east by Lake Michigan, on the south by the main river and on the west by the north branch of the river; the south side being bounded on the east by the lake, on the north by the main river and on the west by the south branch of the river; the west side being that part of the city not included in the foregoing divisions. A clearer idea may be gained by likening the river to the letter Y laid on its side thus: ≻, the main stem pointing to the east or lake. Necessarily a large, proportion of the population of the city is compelled to cross the river by the bridges, of which there are now about 32 and more building. The great number of vessels passing up and down the river — no less than 22,096 for the year ending June 30, 1886 — necessitated the opening of bridges to allow the vessels to pass, but meanwhile pedestrians and vehicles were delayed to their great annoyance and, very frequently, great cost. Vessel owners much preferred making the run of the river during the day rather than night on account of its tortuous passage and the numerous piers of the bridges; consequently, the time for the passage of vessels was somewhat limited. But with the electric light plant in operation, as will be seen by reference to Fig. 1 in connection, the run of the river can be made as well at night as in the daytime. Moreover, the bridges and approaches, some of which were never lighted and most of which

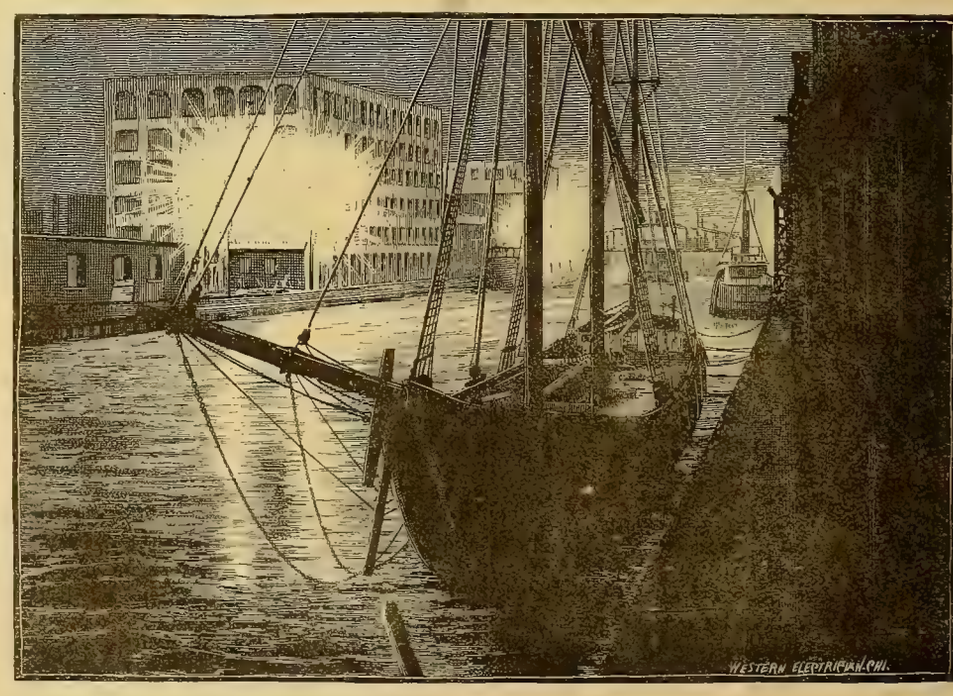


FIG. 1.

were but faintly lighted are now well illuminated much to the comfort of both pedestrians and drivers.

The facilities at the command of Professor Barrett for the establishment of the station were not the best in the world, nevertheless it is hoped that better quarters will be secured when the present station is enlarged in extension of the system.

The station, which was installed by the Western Electric company, of Chicago, is at the corner of Washington and Clinton streets. There are four Western Electric series dynamos each of 30 lights capacity. As will be seen by reference to Fig. 2, the engine is located approximately in the center of a long narrow room, two dynamos at one end of the room belting from one of the engine pulleys, while the other two dynamos are at the other end of the room and belt from the other pulley of the engine. The latter are hidden from sight in the view shown. The engine is a Buckeye of 125 horse power, cylinder 14″ by 16″ and is speeded at about 235 revolutions. The boiler made by the Porter Manufacturing company, limited, of Syracuse, N. Y., is 72 inches diameter by 18 feet long.

In no respect has the work of installation been slighted. Originally, it was the intention to carry the circuits in cables lying on the bottom of the river but specifications in this respect were subsequently changed and the circuits — three in Patterson cables and one in Kerite cable — are carried along the docks in iron pipes, though crossing the river at different places. The conductors are all number 5 B. and S. gauge. In all, there are about eighteen miles of circuit.

The circuits are carried into the dynamo room in Patterson cables and connect to a switchboard, not shown in the view. The station is also provided with four ammeters and to each of the machines is attached an automatic regulator of the Western Electric type.

The lamps used in the circuits are double carbon lamps and they are disposed mainly on iron posts sixteen feet high, though at the bend of the river there is a group of three lamps on a wooden mast 60 feet high. Each lamp is protected by a weather-proof hood and inside of each hood there is a switch for cutting the lamp out of circuit.

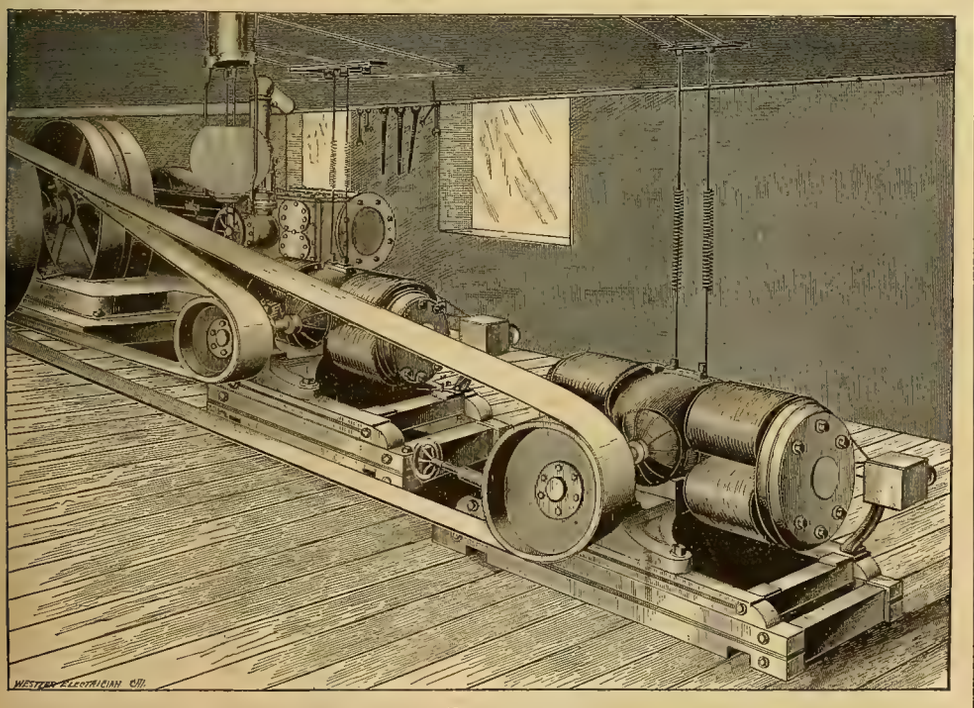


Fig. 2.

Progress of the Art of Illumination.

"We will never dispense with the use of gas probably for illuminating purposes" said an electrical engineer. "I am not one of those who go to extremes in this matter. I believe there is to a place for gas in the future just as I think there is to be a place for both the continuous and alternating systems. Very likely too, the quality of gas will be improved as an illuminating agent. Do you realize that all the recent improvement in lights have been forced on the gas companies by the electric light? I will modify that slightly and say that 99 per cent of these improvements are due to electric light.

"My father was obliged to study over his books by the feeble light of a tallow dip. Think what a boy would do if he were given such a light now. He would strike. As a result of the poor illumination in those times impaired eyesight was frequent. The use of spectacles is not nearly so common now as they were thirty or forty years ago. Statistics establish this fact."

Gas Companies and the Electric Light.

The following significant paragraph is taken from the *Gas World:* "If gas engineers know the business of the electrician better than himself, then so much the better for gas engineers, for assuredly the day will come, and it may not be so far distant as our contemporary in its ignorance supposes, when electric lighting will be combined with the supply of gas. The system of lighting by electricity is being improved and perfected, and the public, to a limited extent, certainly, is calling for installations. We can conceive no bodies better fitted to provide these than gas companies. They at present possess a monopoly, and we think the legislature would be more inclined to favor them than a new company. It is as proper for a gas company as for a corporation to apply for a provisional order to supply the electric light, as well as gas, should it find a demand for the former, and, if such an order were obtained, then all theories about the legality of gas companies supplying both illuminants vanish into thin air. Companies must be guided by circumstances, and if these, as in the case of the Imperial Continental association, point to the necessity of introducing the new system of lighting, then, in the interest of the proprietors, they ought not to hesitate."

Electrical Images.

The phenomenon, first observed by M. Karsten, which occurs when, for instance, a piece of glass separates a sheet of tin foil and a coin, and the metals are connected to a frictional machine in action, is tolerably well known. A very perfect and delicate image of the face of the coin is obtained when the glass is breathed upon. In repeating this experiment, M. Tschechowitch made the curious observation, says the London *Electrical Engineer*, that the image thus obtained may readily be fixed by slightly moistening the glass with a weak solution of stearine, oxide of zinc, or yellow oxide of mercury in benzine. It was also observed that a very distinct image was obtained by coating the glass in the first instance with a very slight layer of vaseline or of a fatty substance; the appearance of the coin is very satisfactorily reproduced on this layer.

The Maximum Efficiency of Incandescent Lamps.[1]

BY JOHN W. HOWELL.

The word efficiency, when applied to an incandescent lamp, is used to designate the amount of energy required by the lamp for the production of a given amount of light; thus we say that a given lamp has an efficiency of 3 watts per candle, at 16 candles, meaning that to produce an illumination of 16 candles we must supply the lamp with 48 watts.

The word efficiency, when applied to a prime mover or to any piece of apparatus that changes energy from one form to another, or which transmits or utilizes energy, has a well defined meaning, and is used to represent the ratio of the energy of the useful effect produced by the apparatus to the energy necessarily supplied to the apparatus to enable it to produce that effect.

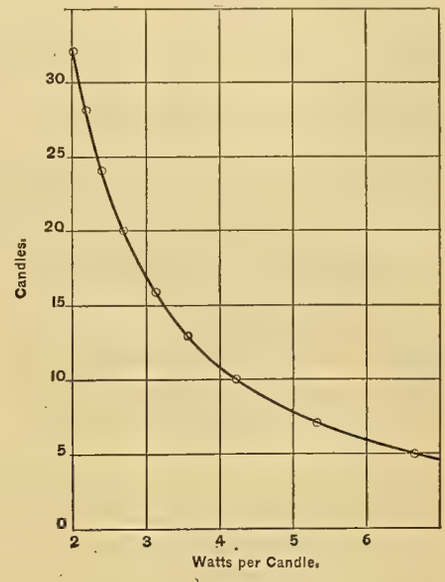


Fig. 1.

An incandescent lamp transforms electrical energy into heat and light, so the use of the word efficiency to denote the watts per candle required by the lamp is not a proper one. To denote properly the efficiency of an incandescent lamp we must be able to separate the energy of the light produced by it from the energy of the heat produced. Then the ratio of the energy of the light to the electrical energy required by the lamp will be a correct expression for the efficiency of the lamp, and we will have to find some other word to designate the watts per candle. In this paper the word efficiency is used in its ordinary improper sense to denote the watts per candle required by a lamp when producing a given amount of light.

The efficiency of a lamp varies with its candle power. The curve, Fig. 1, shows the rate of this variation for a particular lamp. At 5 candles this lamp has an efficiency of 6.7 watts per candle; at 10 candles it is 4.2 watts per candle, and at 20 candles it is 2.66 watts per candle.

Any statement regarding the efficiency of a lamp must, therefore, be accompanied by a statement of the candle power at which it has the stated efficiency; without this it is meaningless. There is nothing in an incandescent lamp itself that fixes its proper efficiency, or in any way indicates what it is. The lamp from which the curve, Fig. 1, was determined has, within the limits of the curve, any efficiency between 2 and 7 watts per candle. Thus, by simply changing the candle power of the lamp, we can operate it at any efficiency we choose, and get as much or as little light per watt as we choose.

In commercial practice the candle power of lamps is always marked on them and their efficiency at this candle power is stated; but even this is not a proper index to the value of the lamp or to its proper efficiency. Experience has shown that lamps are almost universally run above their normal rating; lamps rated at 4.5 watts per candle are usually run at from 3.5 to 4 watts per candle, and in order to make lamps that will stand the strain of being run above their rated capacity, it is necessary to rate them considerably below the efficiency at which they will give the best results under ordinary circumstances.

Lamps have been made and sold in England which have a very high rated efficiency, but parties buying these lamps are told that they will get very much more satisfactory results if they run the lamp below their rated capacity. So we see that some lamps are rated above their capacity and some are rated below, and the rated efficiency of a lamp is not always the best efficiency at which to run it. How, then, are we to determine the efficiency at which a lamp will give the best results? It is this question which I will attempt to answer.

The term maximum efficiency of a lamp, as used in the title of this paper, does not mean the highest efficiency at which a lamp can be operated, but the efficiency at which the best results are produced by the lamp; or more accurately, the efficiency at which the cost of operating the lamp is a minimum.

Taken in this latter sense, the maximum efficiency of a lamp is not its highest efficiency. As we increase the candle power of a lamp its efficiency increases; consequently, by running the lamp high enough we can make its

1 A paper read before the American Institute of Electrical Engineers, April 10, 1888.

efficiency so high that very little power is required to produce a given amount of light, and the cost of the power to produce the light is very small. But, while the efficiency of the lamp increases its life decreases, and if we run a lamp at too high an efficiency the saving in the cost of power is more than balanced by the increased cost of lamp renewals.

To determine the maximum efficiency for lamps under given conditions we must determine the efficiency at which the sum of the costs of power and lamps is a minimum, and in order to do this we must know the rate of variation of a lamp with its efficiency.

The curve, Fig. 2, shows this rate of variation. This curve is the result of very carefully conducted experiments

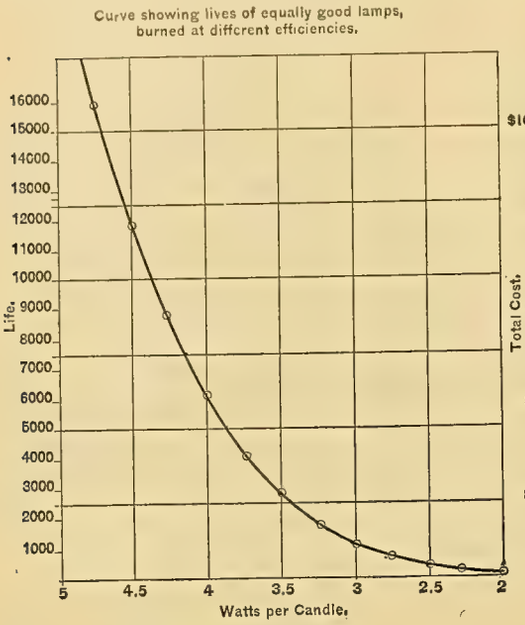


Fig. 2.

made by the Edison company. These experiments extended over five years and consumed a very large number of lamps. Its accuracy when applied to Edison lamps is beyond question; but our experiments with lamps having an artificial surface on the carbon, or "flashed" lamps as they are called, show that their rate of variation of life and efficiency follows a different curve.

This curve does not apply to individual lamps. If we take two Edison lamps and burn them at different efficiencies, their lives for these efficiencies will probably not be such as indicated by the curve, nor will they be proportioned to these indicated lives. But if we take one hundred lamps and burn them at one efficiency, and another hundred and burn them at another efficiency, the average lives of the two sets will be proportional to the lives indicated by the curve for these two efficiencies.

In order to determine at what efficiency the cost of operating lamps of a given quality under given conditions is a minimum we must calculate what this cost is at different efficiencies. To do this we consider the total cost of operating the lamps to be made up of two parts, viz., the cost of the current and the cost of the lamps. The cost of the current is made up of every expense incurred in operating the lamps, including materials consumed, labor, taxes, insurance, rent and every other expense incurred in operating the plant, except the cost of lamps. The cost of the lamps is an item by itself, and is the amount which the lamp has cost when it is put in use. This is a natural division of the total cost of operating a plant, since to produce light by incandescence all that is necessary is a lamp and a current to operate it.

If, in any case, we know the cost of the current required to operate the lamps, the cost of the lamps, the quality of the lamps — that is, the life they will give when burned at a given efficiency,— and the rate of variation of their life with efficiency, we can then calculate at what efficiency the cost of operating the lamps is a minimum, and this I call the maximum efficiency of those lamps.

The following examples show what this maximum efficiency is under varying conditions of the cost of lamps—the cost of current and the quality of the lamps. The cost of the lamps I have varied between 25 cents and $1.00 each. The cost of current varies between 2.5 cents and 10 cents per h. p. per hour. The quality of the lamps varies between 300 hours life at 3 watts per candle, and 2,400 hours life at 3 watts per candle.

In each of the following cases I have calculated the cost of operating 100 candle lamps 1,000 hours, at each of the efficiencies comprised in the curve of total cost. These curves do not show the cost of running the same lamps at different efficiencies but the cost of running equally good 16 candle lamps of the different efficiencies.

The first case we will consider is shown in the diagram, Fig. 3. In this case the lamps are assumed to cost 85 cents each, and to have a life of 600 hours at 3 watts per candle. The current is assumed to cost 10 cents per h. p. per hour.

The cost of the current is determined from the following formula.

$$\text{Current cost} = \frac{\text{w. p c.} \times 16 \times 100 \times 1{,}000 \times \text{cost per h. p. per hour.}}{746}$$

And the cost of lamp from this formula:

$$\text{Cost of lamps} = \frac{\text{cost of one lamp} \times 100 \times 1{,}000}{\text{Life at given efficiency.}}$$

The curve marked total cost shows the total cost of running 100 16 c. p. lamps 1,000 hours, the efficiencies of the lamps varying between 2.5 and 4.25 watts per candle. The

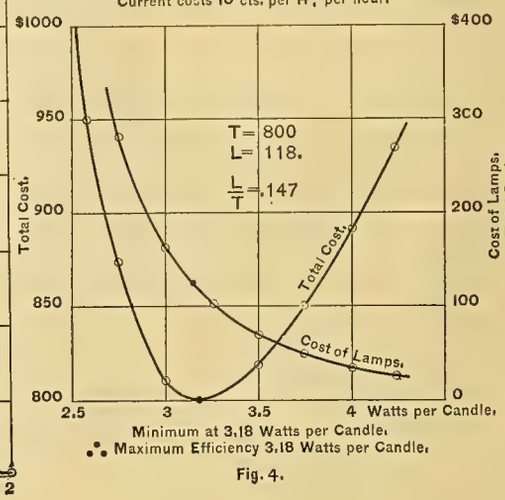


Fig. 4.

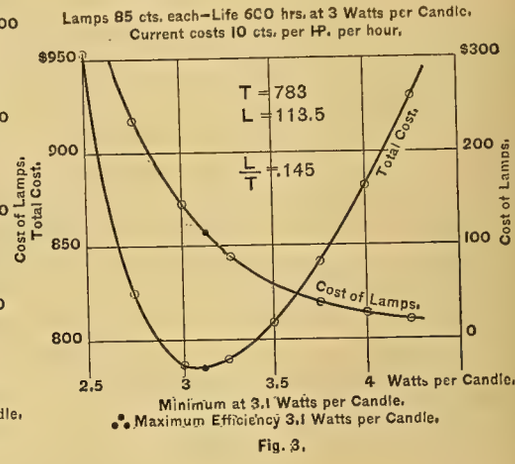


Fig. 3.

In the case shown in the diagram, Fig 5, the current costs 5 cents per h. p. hour; the other conditions are the same as in the case assumed in Fig. 4. The minimum total cost in this case is $444, and to make this cost a minimum we must use lamps having an effic ency of 3.5 watts per candle.

In the case shown in Fig. 6 the lamps cost the same as in the last but are only half as good; the current costs just half as much as in the last case. The minimum total cost in this case is $273 and the maximum efficiency of the lamps is 4.32 watts per candle.

In the case shown in Fig. 7 the lamps cost 50 cents and have a life of 1,200 hours at 3 watts per candle. The current cost 10 cents per h. p. per hour. This is the cheapest and also the best lamp we have yet considered, but the current is expensive. In this case the minimum total cost is $654 and the maximum efficiency of the lamps is 2.62 watts per candle.

In this case, Fig. 8, the current costs half as much as in the previous case, other conditions being the same. The maximum total cost is reduced from $654 to $362. The maximum efficiency in this case is 2.88 watts per candle.

In Fig. 9 the current costs twice as much as in the previous case and the lamps are only half as good. The minimum total cost is doubled, but the maximum efficiency is the same as in the previous case.

In this case, Fig. 10, the current costs one half of that assumed in the previous case, other conditions being the same. The minimum total cost is $400, and the maximum efficiency 3.175 watts per candle.

The curve, Fig. 11, illustrates the case of very cheap and very good lamps, with moderate cost of current. The minimum total cost is low, $291, while the lamps are run at the high efficiency of 2.38 watts per candle.

In the case shown in Fig. 12, the cost and quality of the lamps are the same as in the previous case, but the current costs twice as much. This increases the minimum total cost from $294 to $535 and raises the maximum efficiency to 2.14 watts per candle.

In the case, Fig. 13, the cost of lamps and the cost of current are the same as in the case shown in Fig. 11, but the lamps are only half as good. The minimum total cost is increased from $294 to $327 and the maximum efficiency is reduced from 2.38 to 2.62 watts per candle.

The first and plainest inference drawn from these curves is that the maximum efficiency of any given lamp is not a fixed one, but varies with conditions outside the lamp itself. Identical lamps operated under different conditions of cost of current must be burned at different efficiencies to make the cost of operation a minimum for the production

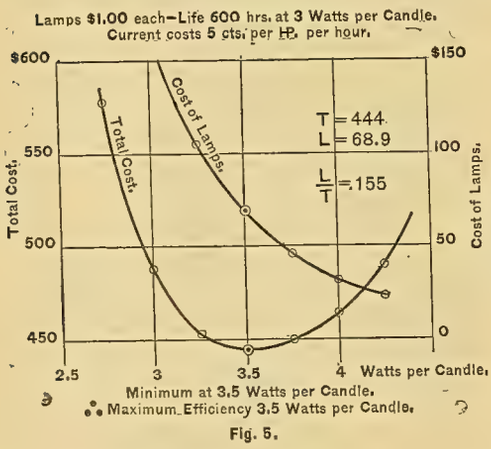


Fig. 5.

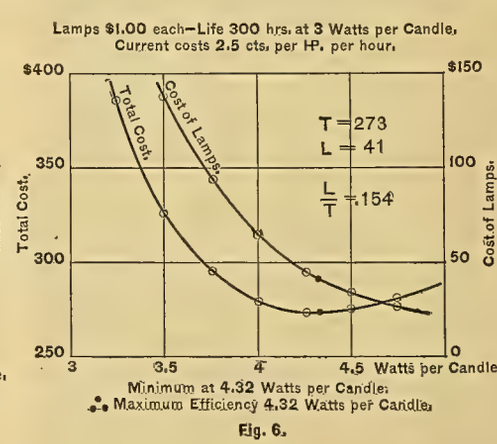


Fig. 6.

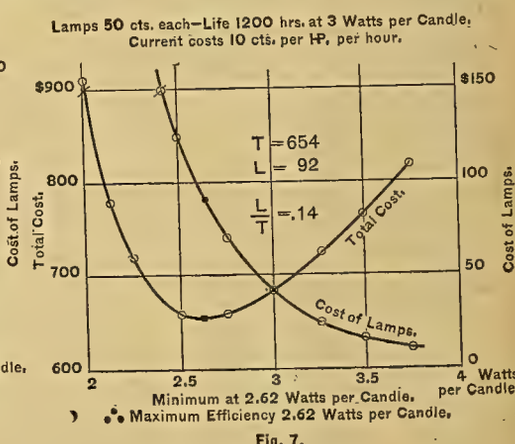


Fig. 7.

efficiencies are shown by the vertical lines, referring to the scale at bottom. The value of the total cost at any point of the curve is shown by the horizontal lines through the point, referring to the scale at the left of diagram.

The lowest point of the curve shows the point where the total cost is lowest. This is the minimum cost of operating these lamps under the given conditions. The mark at the lowest point of the curve shows this minimum cost to be $783, and a vertical line through this point to the scale at bottom of the diagram shows that this total cost is a minimum when lamps having an efficiency of 3.1 watts per candle are used. Thus the maximum efficiency of these lamps under the conditions assumed is 3.1 watts per candle.

The lamps considered in the case shown in Fig. 4 cost $1.00; all other conditions are the same as in the case shown in Fig. 3. This increases the total cost from $783 to $800, and necessitates using lamps of 3.18 watts per candle instead of 3 1, to make the cost of operating a minimum.

of a given amount of light. In order to determine the maximum efficiency of lamps, therefore, we must know the quality of the lamps referred to some standard, the cost of the lamps to the consumer, and the cost of current under the actual conditions existing at the place where the lamps are to be used.

In the eleven cases shown in this paper the lamp of highest efficiency is obtained in the case shown in Fig. 12 This is a case where the lamps are very cheap and very good, and current very expensive. The lamp having the lowest efficiency is obtained in the case shown in Fig. 6, in which the lamps are poor and high priced and the current is very cheap.

There is a marked difference in the sharpness of these curves at the minimum points. An inspection will show that the sharpness of the bend in these curves depends upon the cost of the current, the curve in which the current

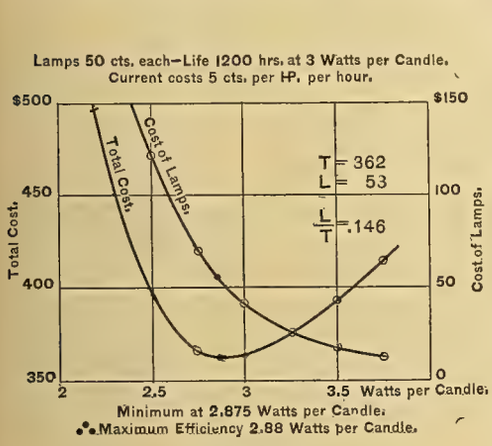


Fig. 8.

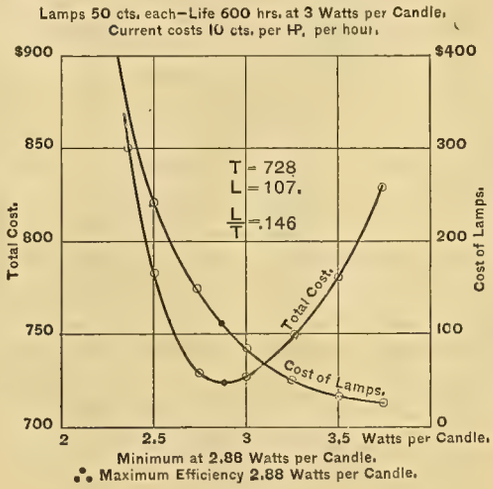


Fig. 9.

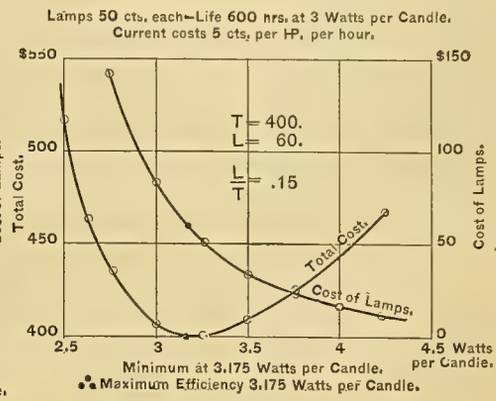


Fig. 10.

costs 10 cents per h. p. per hour being the sharpest. Those in which the current costs 5 cents are next, and the one, Fig. 6, in which the current costs only 2½ cents per h. p. per hour, is very flat at the bottom or minimum point. In this comparison Fig. 7 is not considered, as it is drawn on a different scale from the others, and is not as sharp as it should be.

This indicates that the more expensive the power is, the more carefully must the lamp efficiencies be chosen. In Fig. 12, which shows the sharpest curve, a very slight variation in the efficiencies of the lamps makes a very great change in the total cost of operation.

In the case shown in Fig. 6, in which the current is very cheap, we find that a very considerable change in the efficiency of the lamps used makes very little difference in the total cost of operation.

On each of the eleven plates two curves are drawn, one showing the total cost of operation, and the other showing the cost of lamps. On each of the curves showing the cost

mum efficiency, for we have seen from the above curves that where the cost of current is high the use of lamps whose efficiency is a little above or below the maximum efficiency attainable under the conditions of operation, makes a very marked increase in the operating expenses of the plant.

If in any plant the lamp bills are only 10 per cent. of the total expenses then increasing the efficiency of the lamps by increasing their candle power does not diminish the total cost of operating the plant. In order to reduce the total cost the lamps must be replaced by lamps of the same candle power but of higher efficiency. If the efficiency of the lamps is increased by raising their candle power, the cost of operating the plant per unit of light produced is reduced, but the total cost is increased. A plant which is paying less than 15 per cent. of its total expenses for lamps, and which brings the lamp bills up to 15 per cent. by increasing the candle power of the lamps does not decrease the cost per lamp of operating the plant, but does decrease the cost

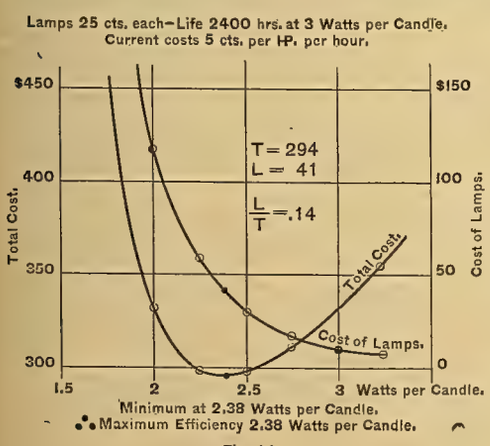


Fig. 11.

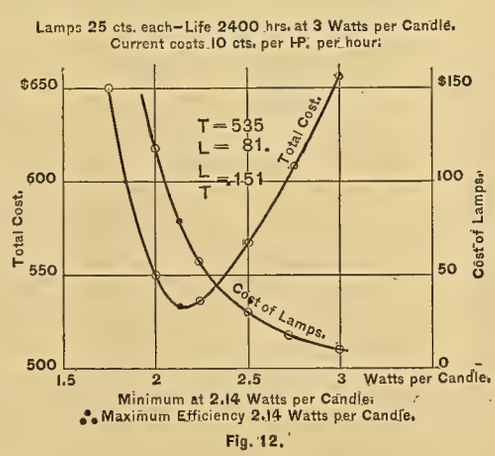


Fig. 12.

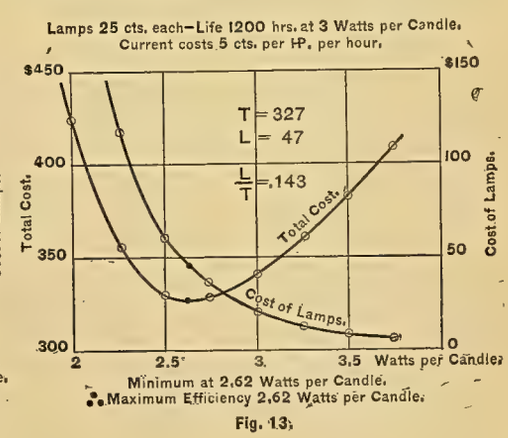


Fig. 13.

of lamps a point is marked which indicates the cost of the lamps when the total cost is a minimum. An examination of all these curves shows that while the minimum total cost varies with each of the three quantities—price of lamps, quality of lamps and cost of current—nevertheless, the total cost is always a minimum when the cost of lamps is about 14.5 or 15 per cent of the total cost of operation.

This figure varies somewhat in the different examples considered, but the variation seems to follow no law. In Figs. 6 and 12 which show the highest and lowest efficiency lamps the figures are 15.1 per cent and 15.4 per cent respectively.

The steepness of the curve showing the cost of lamps, and the difficulty of determining the exact minimum point of a curve which has been drawn by inaccurate methods makes it difficult to get the cost of lamps accurately when total cost is a minimum. These curves and values are given just as they were determined, and no effort has been made to bring the results into closer agreement, as could readily have been done. I consider the variation shown by these curves to indicate closely enough

per candle of light furnished. If they are paid for the increased light given by the lamps the efficiency of the plant is made a maximum for the existing conditions; but if they are not paid for the additional light furnished the efficiency of the plant is reduced.

This law enables any one operating an incandescent lamp plant to determine whether or not he is using the most suitable lamps for his plant. If the conditions of operation of a new plant are all known, and the quality of the lamps made by any lamp maker is known, we can determine before starting what is the most economical lamp to use.

In Favor of The Bell Company.

A despatch from Baltimore announces that in the United States circuit court in the case of the Bell Telephone company against the Emmner Improved Telephone company, Judge Bond has ordered a decree for the Bell company. The case of the same company against William C. Trumbull and others was also called and a decree for the Bell company ordered. The last named is the case in which Count Mitkiewicz figured.

Remarkable Exhibition of Atmospheric Electricity.

A correspondent writes to the London *Electrician*:—A most violent discharge of electricity was observed on board the Danish steamer Constantin, coming from Newcastle and bound for Copenhagen, on Friday morning, February 10th, when about 160 miles distant from the English coast. Although the thermometer was at freezing point, thunder and lightning began some way off, between 4 and 5 o'clock a. m. About 6 o'clock a tremendous report was heard, sounding like thunder, and the captain describes the appearance of the vessel as if it were shrouded in a mass of bright red flames, which lit up the surrounding waves. The phenomena was all the more surprising as the thunder and lightning appeared to be at some considerable distance from the steamer, and it could not be compared to an ordinary thunder clap and lightning flash, being far too violent and no regular flash of lightning being seen. The shock was so great that several men in various parts of the ship were knocked down, and the first engineer was under the impression that a boiler explosion had taken place The whole thing only lasted a moment, but it was attended by a violent wind, and St. Elmo's lights were seen on the tops of the masts and elsewhere. On arriving at Copenhagen the captain found his suspicions confirmed of alterations having taken place in the deviation of the ship's compases. The alterations were greatest on S.S.E. and N.N. W. courses, where the deviation, from having been 7 degrees westerly, had become 5 degrees easterly. The vessel was, when the electrical discharge took place, steering E. to N.

When electricity becomes the agent of punishment for crime, the judge's "charge" will have more significance than it does now.—*Pittsburgh Chronicle.*

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A NEW English made dynamo of the Kapp type is shown in this issue. Its chief merit seems to be in its novelty.

THE *American Miller* is publishing a series of articles on "Mill fires, their causes, how to prevent them." An excellent starting point in preventing fires in mills is to discard old-fashioned methods of illumination and to substitute a safe illuminant like electric light.

ON speaking of the proceedings of the Electric Light convention at Pittsburgh the London *Electrician* says rather mournfully: "The papers were, as a rule, of the usual practical character, embodying the results of experience in arc and incandescent lighting on a scale which is unhappily quite unapproachable in this country."

IN a paragraph quoted in another column the *Gas World* sets forth the advantages which would accrue to the representatives of the electric light and gas industries if they would endeavor to act in harmony. The position taken by the *Gas World* is similar to that expressed recently by Frank Ridlon, ex-president of the Boston electric club, in his brief address recently before the convention of New England gas engineers.

THE London *Electrical Review* says: "Yes, bad workmanship has a great deal to answer for in America. There is plenty of it in England, but it is seen on a larger scale in the states. Our electrical contemporaries there have latterly taken note of the importance of the subject, and have issued strong warnings." But it should be borne in mind that practical electrical work is performed on a much larger scale in the United States. Perhaps that fact can account for the greater amount of bad workmanship.

THERE seems to be a change in opinion at Washington in reference to the Bell telephone suit. The prevailing impression is that no rehearing will be granted by the United States supreme court. Judge Miller is quoted as saying that in the twenty-five years he had been on the supreme bench there had been but ten rehearings. Those who give it as their opinion that there is no probability of a reopening of the case say that in a case like the telephone suit, if the bench is nearly equally divided, every point bearing on the case in the most remote degree is thoroughly canvassed, and nothing in any way bearing on the case is passed over. But when the bench is unanimous or nearly so a decision may perhaps be reached without so thorough a canvass of all phases of the subject, and some minor point may be overlooked and a rehearing granted.

THE most formidable petition ever presented to Congress was that introduced Thursday. The petitioners ask for the establishment of a government telegraph system. This is the outcome of the action taken by assembly of the Knights of Labor. The appeal represents 325 congressional districts and eight territories. The petitions are accompanied by pamphlets giving the arguments in favors of a governmental telegraphic system. This is the gist of the appeal for the change, "We believe that the necessity actually exists to day for the government to establish this system; that the blessings of the telegraph system are being denied to a large majority of our people because the system is monopolized by a few men as a money making scheme, while it ought to be controlled and run by the government as a great public necessity."

THE comparative value of the continuous and alternating currents for electrical distribution is a topic that is engaging widespread attention and discussion. As stated last week the discussions in the Chicago Electric club on this subject have awakened attention in both America and Europe. Discussions in English electrical circles on the same matter have been going on for some time as has been shown by republications in the columns of the WESTERN ELECTRICIAN of papers by leading English electricians. This week Mr. Mackenzie's paper on electrical distribution by means of transformers, is concluded and a summary of the points made in the discussion, by members of the London Society of Telegraph Engineers and Electricians, of that paper and another by Mr. Kapp is given. Mr. Crompton takes up the matter of the cost of central station lighting by the storage battery system and by the alternating system and concludes that the estimates of the cost of 10,000 60 Watt lamps is approximately the same for both systems—in the former £48,790 and in the latter £48,740. A careful review of the figures, even with totals approximated shows a discrepancy in the cost under the storage battery system, an addition of the figures given being £46,790 instead of £48,790, a difference of £2,000 or about $10,000, and accordingly, if the figures be correct, the conclusion is vitiated but nevertheless the result is more in accord with Mr. Crompton's inclination toward the accumulator system carried out in the construction of the central station at Kensington Court reference to which is also made on another page.

Mr. Manville also has something to say in regard to coupling alternating dynamos in parallel, refers to accomplishments in this line in America and concludes that the concensus of opinion in England in favor of distribution by means of transformers is fully justified and strengthened by what is being daily achieved in this country.

The general topic is one that is bound to engage close and careful attention and the papers and discussions carrying new ideas and bringing out new facts are particularly valuable at the present time to our readers.

THE two points which chiefly concern every producer as well as every consumer of light, are efficiency and cost; and in the article on the efficiency of incandescent lamps, to be found in our columns this week, these two points are set forth in a very careful, practical manner. The writer at the outset carefully discriminates between the heat and the light produced; the light alone being the efficient product, he ignores the heat. This point however is well taken; electric energy is transmuted into two kinds of energy, heat and light, produced simultaneously, and it becomes an interesting and highly practical problem to determine to what extent the one is produced at the expense of the other; or how we may obtain the greatest amount of light with the least amount of heat, on the most economical basis.

The next important discrimination is between the cost of lamps and the cost of current, and the writer shows that the most costly lamp, or what might be considered the one of best construction, is not by any means the most economical, or the best to use; that the relations between cost of lamp in proportion to its life, and cost of current are such, that 50 cent lamps are found to be more efficient and economical than dollar lamps.

On this point it will be noticed that the writer confines his estimates exclusively to Edison lamps, and discriminates between them and lamps with flashed filaments, which it would seem the Edison company does not use. Hence it is important that the makers of the flashed lamps should be heard from.

The average method of comparison which the writer adopts shows great care and discrimination; 100 16-candle lamps of one kind, at 1,000 hours, are compared with the same number of another kind, for the same time. In his conclusions, the writer shows that the most economical and efficient system is one in which the cost of lamps consumed is about 15 per cent of the cost of current consumed; each representing a fractional part of the entire cost, all things included, and the two taken together, the whole cost.

One very important practical point demonstrated is, that in the relations between lamp and current, the expensive current requires much greater care in regard to the efficiency of lamps to produce the most economical results than the cheaper current. With a ten cent per h. p. hour current, a slight variation in lamp efficiency makes a great difference in total cost of operation, while with a five cent current a considerable variation in lamp efficiency makes but slight difference in the cost. Hence, where causes combine to increase cost of current, greater discrimination in regard to lamp efficiency is necessary than where current is obtained at cheaper rates.

THE subject of revision of the patent law and patent office practice is again called to attention by the publication on another page of copies of bills introduced into congress by the Legal committee of the National Electric Light association. We believe these bills will be much more satisfactory to electrical men who are so largely interested in patents than the proposed original bill looking toward the appointment of an expert commission, who should consider a revision of the patent laws and methods and report to congress recommended changes. The original intention was abandoned on account of the unanimity of opinion prevailing among members of the association that to open the question of general revision would be to expose the system to attacks of enemies and might result in doing it injury. The bills now introduced are aimed at specific changes which will without doubt improve both law and practice.

Arthur Steuart, general counsel of the association, gives a very clear and able summary of the objects sought in the bills introduced in a letter to the WESTERN ELECTRICIAN.

"We propose to establish a Court of Patent Appeals, to be composed of expert patent lawyers," he writes, "so that we may feel in going before that court with a case involving technical cases of steam or electrical engineering that the judges will be fully equal to the task of comprehending the problem presented to them, and of deciding the case in a thoroughly intelligent manner. It is also very desirable that this court should sit to hear appeals from the commissioner of patents, as well as from the Circuit courts, so that all questions relative to patents either in relation to their issuance, or in relation to rights, and questions of infringement growing out of them, may be passed upon by the same appellate tribunal, and rules of law announced by a single competent body, for the guidance and government of these two branches of the service.

"The bill which provides for the alteration of Section 3,887 removes the limitation which has heretofore existed on United States patents, by foreign patents of prior date, while at the same time retaining the rule that foreign patentees must make application for their patents in this country, within two years of the date of their foreign patent."

The desirability of having a thoroughly equipped man at the head of the patent office and the importance of making it for that man's interest to remain in that position will undoubtedly be conceded. The present confused condition of the patent office is attributed to the fact that in twenty years, the commissioners of patents as a rule have been men who knew but little of the duties of the office when they assumed them and whose terms of office have averaged only between thirteen and fourteen months each. By increasing the compensation of the office to $8,000 per annum and fixing the term at six years, it is hoped to remove the office from the control of politicians and to make it for the interest of an incumbent worthy of the office to hold it.

The Cost of Central Station Lighting.[1]

BY R. E. CROMPTON.

No one will doubt that with the accumulator transformer system, the generating station can, in a majority of cases, be placed at a distance not exceeding one mile from the nearest part of the district requiring electricity for light or power, and in such cases the cost of plant will only slightly, if at all, exceed that for an equivalent supply from alternating transformers. At Vienna is a central station charging groups of batteries continuously in series. From each group extend four circuits so as to reduce the e. m. f. from 400 volts to 100, to suit the lamps used. This installation has been in successful operation continuously for six months without hitch or trouble of any kind. There has, it is true, been trouble with the boilers but none with the electric plant. No difficulty has been experienced in charging continuously at the high pressure necessary, and no danger or difficulty has arisen from it, though no special precautions were taken with the wiring in the opera house or elsewhere. This proves that a system which uses a charging current at sufficient potential to fully charge four batteries arranged in series, at 100 volts each, supplying during the average maximum demand for electricity, two thirds of the current direct from the dynamos without the slightest loss, and one-third only from the accumulators, can be operated successfully and economically, and with a far greater margin of security against temporary stoppages of the light than could possibly be done with either alternate or direct current transformers without storage.

Comparing the cost of an installation on the battery system with one of equal capacity on the alternating system, motive and dynamo power may first be considered. With the battery system, the dynamos can supply two-thirds of a maximum net output of 600 kilo watts, and since there would be no loss of current but only of e.m.f. in the regulating appliances, which may be safely taken at 12 per cent., we require 448 kilo watts at the terminals of the batteries, or, adding 10 per cent. loss in the mains, 500 kilo watts in the generating station. If to this be added 20 per cent. of extra motive and dynamo force, allowed as a reserve, we must provide for 600 kilo watts, equal to 1,000 i. h. p. Such a plant may conveniently consist of six sets of combined engines and dynamos, each of 100 kilo watts, or 166 i. h. p. Taking £8 12s. per i. h. p. as a basis, the cost of motive power would be £8,700, and of dynamo power £4,800. For the alternating system 1,450 i. h. p. at £8 12s. comes to £12,500, and for the dynamos and exciters £5,540. For site and buildings in each case there should be added £8,000 for the battery system and £11,000 for the alternating.

The charging mains of the battery system would extend only from the generating station to the accumulator stations within the district. Taking the length of this main at one mile exterior to the district and 240 yards within it, or 2,000 yards in all, and doubling this for the complete circuit, we have 4,000 yards; and with a current of 1,200 amperes, allowing 10 per cent. or 40 volts for loss, the resistance must be .04 ohms. A double conductor having 2.55 square inches collective area, weighing about 45 tons, and costing at £80 per ton £3,650 would be sufficient. This can be laid on porcelain insulators in a cemented brick culvert for £1,500, making the entire expense of conductor and culvert £5,150. The alternating system would require, practically, the same length of mains laid in a similar manner, hence, for the sake of convenience, the cost of street work may be considered common to both. The cost of the cheapest and most reliable method of laying underground mains in London varies from 14s. per yard of double main of minimum size for 40 amperes, to 16s. for copper conductors of ¼ inch section.

The probable house frontage required for a supply of 10,000 60-watt lamps burning simultaneously must next be considered. Recent experience in London, and elsewhere, shows that the ampere at 100 volts, i. e., 100 watts of useful frontage is a good practical figure. For the 6,000 ampere or 600 kilo watts we supply 6,000 yards of useful frontage, but 50 per cent. in excess of this must be supplied with mains for frontage where the light is not used, making 9,000 yards, to which must be added 35 per cent. for crossings and vacant spaces, making 12,000 yards in all, which for the battery system with ¼ inch section conductors would cost £9,600; and for the alternating system, at the smallest useful section £8,400. To the latter figure must be added £2,400 as the cost of one mile outside the area of supply.

Referring to house connections; when underground conductors are used, it is necessary to provide one surface box with connections for every two houses; and as all these must be put down when the mains are laid, we must estimate for their supply for both systems. House fronts in London vary from 24 to 60 ft., and taking 10 yards as the average, a surface box would be required for every 20 yards, or 450 boxes for the 9,000 yards of useful frontage, which at £2 per box would be £900 to be added to both estimates.

The battery transformers must furnish 200 kilo watts per hour during the hours of maximum supply, which in London average three hours per day in winter. With four batteries, having a total capacity of 1,000 kilo watts we provide for five hours of extreme demand, not likely to occur even in times of fog. Each of these batteries would have a capacity of 250 kilo watts, and could be discharged at fair efficiency at a rate of not less than 650 kilo watts. Such batteries set up in working order would cost £8,640; with a guaranteed rate of 250 kilo watts per battery in cases of emergency, such as a break down of the charging plant or charging mains, without the slightest risk of injury to the battery. Such provision would be ample for any possible contingency, even at the period of maximum demand. But in all such cases, when ample allowance has been made for spare machinery, and with the charging mains laid and insulated in two parallel sections, such stoppages are not likely to extend beyond a few minutes, so that in this point the battery system offers enormous advantages over its rivals.

In the alternating system, for the 9,000 yards of mains required to light simultaneously 10,000 lamps, on a frontage of 900 houses, 600 of which would take light, 600 transformers, or one for each consumer, must be provided; and at the lowest estimate this could not be done, all things included, at a cost of less than £20 per house, or £12,000 for the whole. But even if one transformer could be used for every two houses, the total cost would not be less than £7,500.

The conclusion arrived at from these estimates is that the cost of 10,000 60-watt lamps supplied simultaneously, is approximately the same for both systems, viz., £49,000, as shown by the following comparative tabular view:

	Storage Battery System	Alternating System.
Motive power, six 166 i. h.p sets = 996 i-h. p. at £8. 12s.	£8,700	
" " 1450 i. h p. at £8. 12s. per i. h.p.		£12,500
Dynamos	4,800	
" and Exciters		5,540
Building to suit above	8,000	11,000
Charging main, 45 tons at £80	3,650	
Laying charging main in culvert	1,500	
Charging main		2,400
Distributing main, 1,200 yds. at 16s. yd	9,600	
" " " " 14 "		8,400
Service boxes, 450 at £2.	900	900
Batteries, four sets of 50 cells each	8,640	
Regulating gear	1,000	500
Transformers, one for 2 houses, 300 at £25, including fixing		7,500
	£*48 790	£48,740

*[The figures are given as printed originally. The footing of this column should be £46,790. Ed. W. E.]

[1] Abstract of paper in *Industries*, March 16.

Secondary Battery Plates.

Following is a description of Dujardin's method of forming secondary battery plates: The lead plates are put into a solution of sulphuric acid and sodium nitrate in water (10 of water, 2 of sulphuric acid, 1 of sodium or potassium nitrate), and a current is sent through the cell. By the passage of the current, nitrate of lead is formed, the lead being dissolved from the positive plate; and this is changed into sulphate of lead and afterwards by the current into peroxide of lead. In a few hours the plate is covered with a layer of crystalline peroxide of lead. During the formation, air is forced through the cell, or the plates are lifted from the liquid at intervals. In the absence of data as to the performance of plates formed in this way, it is impossible to compare them with the ordinary grid plates, pasted with red lead by the Faure process. The type of cell under which that of M. Dujardin comes—the Platè form—generally offers the advantage of quicker discharge rate, and freedom from "buckling," as against the greater storage-capacity of the Faure type. How far M. Dujardin has remedied the difficulties of the type outside of the time necessary for formation, remains to be seen.

Patent Law Revision.

Following are copies of bills that have been introduced in the Senate and House of Representatives of the United States Congress, having in view the improvement of the condition of the patent system:

A BILL TO ESTABLISH A COURT OF PATENT APPEALS OF THE UNITED STATES, AND TO AMEND SECTIONS 4911, 4,912 AND 4,915 REVISED STATUTES, AND SECTION 780 REVISED STATUTES, RELATING TO THE DISTRICT OF COLUMBIA.

Be it Enacted, by the Senate and House of Repesentati es in Congress assembled:

SEC. 1. There shall be a Court of Patent Appeals of the United States, which shall consist of a chief justice and four associate justices, who shall be appointed by the president, by and with the advice and consent of the senate, and who shall hold office during good behavior. Any three of said justices shall constitute a quorum.

SEC 2. The associate justices shall take precedence according to the dates of their commission, or when the date of the commission of two or more of them is the same, according to their ages.

SEC. 3. In case of vacancy in the office of chief justice, or of his inability to perform the du ies and powers of his office, they shall devolve upon the associate justice, who is first in precedence, until such disability is removed, or another chief justice is appointed and duly qualified. This provision shall apply to every associate justice who succeeds to the office of chief justice.

SEC. 4. The justices of the Court of Patent Appeals shall receive the sum of eight thousand dollars each per annum, to be paid monthly.

SEC. 5. The Court of Patent Appeals shall have power to appoint a clerk and a marshal for said court, and a reporter of its decisions.

SEC. 6. One or more deputies to the clerk of the Court of Patent Appeals may be appointed by the court on application of the clerk, and may be removed at the pleasure of the court. In the case of the death of the clerk, his deputy or deputies shall, unless removed, continue in office and perform the duties of the clerk in his name until a clerk is appointed and qualified; and for the default or misfeasance in office of any such deputy, whether in the life-time of the clerk or after his death, the clerk and his estate, and the sureties on his official bond shall be liable, and his executors and administrators shall have such remedy for such default or misfeasance committed after his death, as the clerk would be entitled to if the same had occurred during his life-time.

SEC. 7. The marshal shall be entitled to receive a salary at the rate of two thousand dollars a year. He shall attend the court at its sessions, shall serve and execute all processes and orders issuing from it, or made by the chief justice or an associate justice in pursuance of law, and shall take charge of all the property of the United States used by the court or its members. With the approval of the chief justice he may appoint assistants and messengers to attend the court, with the compensation allowed to officers of the House of Representatives of similar grade.

SEC 8. The reporter shall cause the decisions of the Court of Patent Appeals, made during his office to be printed and published within six months after they are made, and within the same time, shall deliver three hundred copies of the volumes of said report to the secretary of the interior. And he shall, in any year when he is so directed by the court, cause to be printed and published a second volume of said decisions, of which he shall deliver in like manner and time, three hundred copies.

SEC. 9. The reporter shall be entitled to r ceive from the treasury an annual salary of twenty-five hundred dollars, when his report of said decisions constitutes one volume, and an additional sum of fifteen hundred dollars when, by direction of the court, he causes to be printed and published in any year a second volume. But said salary and compensation respectively shall be paid only when he causes such decisions to be printed, published and delivered within the time and in the manner prescribed by law, and upon the conditions that the volumes of said report shall be sold by him to the public for a price not exceeding four dollars a volume.

SEC. 10. The three hundred copies of the reports of the Court of Patent Appeals shall be distributed by the secretary of the interior as follows: To the commissioner of patents forty copies, and the balance as provided in section 683 of the revised statutes for the distribution of the Supreme court reports.

SEC. 11. The Court of Patent Appeals shall hold at the seat of government one term annually, commencing on the second Monday in October, and such adjourned or special terms as it may find necessary for the dispatch of business.

SEC. 12. If at any session of the Court of Patent Appeals a quorum does not attend on the day appointed for holding it, the justices who do attend may adjourn the court from day to day for twenty days after said appointed time, unless there be sooner a quorum. If a quorum does not attend within said twenty days, the business of the court shall be continued over until the next appointed session; and if during a term, after a quorum has assembled, less than that number attend on any day, the justices attending may adjourn the court from day to day until there is a quorum, or may adjourn without day.

SEC. 13. The justices attending at any term when less than a quorum is present, may, within twenty days mentioned in the preceding section, make all necessary orders touching any suit, proceeding or process, depending in or returned to the court, preparatory to the hearing, trial or decision thereof.

SEC. 14. The Court of Patent Appeals of the United States shall have appellate jurisdiction in cases hereafter specifically provided for without regard to the sum in controversy:

1. From the Circuit courts of the United States and from the Supreme court of the District of Columbia in all cases touching patents, copyrights, trade-marks and labels.

2. From the commissioner of patents in all cases touching patentability of inventions, priority of invention among several claimants for patent upon the same invention and the judicial practice of the Patent Office, also all cases touching the registration of trade-marks or labels and the rights of conflicting claimants therefor.

SEC. 15. From and after the passage of this act, there shall be no appeal from the Circuit courts of the United States in cases touching patents, trade-marks, copyrights or labels, to the Supreme court of the United State directly, but all such cases formerly appealable to the Supreme court shall be heard on appeal by the Court of Patent Appeals.

SEC. 16. There shall be a right of appeal from the Court of Patent Appeals, to the Supreme court of the United States in all cases which individually involves $100,000, or more, exclusive of costs; and an appeal may be taken by the defeated party, to the Supreme Court of the United States from any final judgment or decree of the Court of Patent Appeals, when the latter court deems the questions involved to be sufficiently important and sufficiently doubtful, to justify such an appeal, and therefore consents that such an appeal be taken.

SEC. 17. All cases touching patents, trade-marks, copyrights or labels, now pending before the Supreme court of the United States awaiting trial may, at the option of the parties interested, be transferred to and heard by the Court of Patent Appeals.

SEC. 18 When any judge of the Court of Patent Appeals resigns his office after having held his commission as such, at least ten years, and having attained the age of seventy years, he shall, during the residue of his natural life, receive the same salary which was by law payable to him at the time of his resignation.

SEC. 19. Section 4,911 of the revised statutes shall be, and hereby is amended so as to read as follows: If such party is dissatisfied with the decision of the commissioner he may appeal to the Court of Patent Appeals of the United States.

SEC. 20. Section 4,912 of the revised statutes shall be, and hereby is amended so as to read as follows: When an appeal is taken to the Court of Patent Appeals the appellant shall give notice thereof to the commissioner, and file in the Patent office, within such time as the commissioner shall appoint, his reasons of appeal, specifically set forth in writing.

SEC. 21. That section 4,915 of the revised statutes of the United States is hereby repealed.

SEC. 22. That section 780 of the revised statutes, relating to the District of Columbia, is hereby repealed.

SEC. 23. All acts or parts of acts inconsistent with the provisions of this act are hereby amended so as to be consistent therewith.

A BILL TO AMEND SECTIONS 476, 477, OF THE REVISED STATUTES OF THE UNITED STATES:

Be it enacted, by the Senate and House of Representatives in Congress assembled,

That sections 476 and 477 of the revised statutes of the United States, be hereby amended so as to read:

"SEC. 476. There shall be in the patent office a commissioner of patents, one assistant commissioner, and three examiners in chief, who shall be appointed by the president, by and with the advice and consent of the senate. The commissioner of patents shall hold office for six years from the date of his appointment. All other officers, clerks and employes authorized by law for the office shall be appointed by the secretary of the interior, upon the nomination of the commissioner of patents."

"SEC. 477. The salaries of the officers mentioned in the preceding section shall be as follows:

"The commissioner of patents, eight thousand dollars a year.

"The assistant commissioner of patents, three thousand dollars a year.

"Three examiners-in-chief; three thousand dollars a year each."

The legal committee of the National Electric Light association had proposed presenting a bill to the same purport as the following, but finding that the appended had been introduced they will favor its passage.

This bill was introduced by Mr. Atkinson, has been read twice, referred to the committee on patents, and ordered to be printed.

A BILL TO AMEND SECTION 4,887 OF THE REVISED STATUTES IN RELATION TO PATENTS.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled.

That section forty-eight hundred and eighty-seven of the revised statutes shall be, and hereby is, amended so as to read as follows:

"SEC. 4887. [No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent hereafter granted be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application; but every patent hereafter granted for an invention which has, prior to the filing of the application for said patent, been patented in a foreign country, shall expire seventeen years from the date of the foreign patent, or, if there be more than one, seventeen years from the date of the earliest foreign patent, and in no case shall it remain in force more than seventeen years; but all applications hereafter made for patents for inventions previously patented in a foreign country, upon the invention of the same person, shall be made within two years from and after the date of such foreign patent, or, if there be more than one, from the date of the earliest foreign patent. No patent granted for an invention which had, prior to the grant of such patent, been first patented in a foreign country, and which has not expired at the date of the passage of this act, shall be declared to be invalid by reason of its not being so limited on its face or in its grant as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term; but this section shall in no wise renew, revive, prolong or extend any patent heretofore granted."

The Alternating vs. The Continuous Current System.

The discussion of Kapp's and Mackenzie's papers on transformers at the recent meeting of the London Society of Telegraph Engineers and Electricians elicited numerous interesting and important facts and opinions by leading electricians, some of which are in substance as follows: Captain Cardew maintained that there was very great risk to life in the alternate transformer system which "could not be considered chimerical;" that since in the transformer there were two conductors in close contact, thinly insulated, and with an iron core, one of which might acquire a potential difference of 2,000 to 2,400 volts over the other, there was certain to be in the primary circuit a resultant leak, and the conditions were favorable to an eventual breakdown, hence the obvious importance of some safeguard the presentation of which he had waited in vain to see; consequently he had invented one of his own, consisting of an iron box inclosing two disks of aluminum foil separated by a narrow partition, and laid in a shallow depression in the bottom to prevent lateral displacement. This he termed the bait. Just above this was an insulated disk connected to a piece of fine wire which supported a spring and connected the disk to any point on the secondary circuit. The box was connected to the earth and the distance of the insulated disk could be adjusted by a screw. There was also a little disk which indicated the distance of the insulated disk above the aluminum foil. Should the secondary circuit acquire a potential differing from the earth by more than whatever voltage the safety device was set for—500 or upwards—the aluminum foil would be attracted statically and brought into contact with the disk attached to the fine wire, and instantly repelled, but the result of this instantaneous contact would be the formation of an arc and the fusing of the fine wire, releasing the spring by which the primary circuit was short-circuited and the double pole cut-outs put in operation. He exhibited one of the little foils which had been used repeatedly, had stood an alternating potential of 2,400 volts, and was but slightly injured.

N. Bernstein presented some points of difference between putting transformers in series and in parallel. The question of insulation with high tension alternating currents became a very serious one as shown by Captain Cardew. For transformers used in parallel two main conductors were required, which had to be placed very close together to prevent induction on other wires, and between which there was a difference of potential of say 2,000 volts, conditions which made insulation extremely difficult. With transformers in series the highest difference of potential was at the dynamo, while the difference along the line was constantly reduced, so that the mean difference was only half as much and the tendency to produce a leak only a quarter as great. On a parallel system there is in the transformer itself the same mean potential difference of 2 000 volts between the ends of the coil, and as the construction of an efficient transformer did not admit of heavy insulation there was liability of leakage occurring.

But in a series transformer this potential difference could be reduced to 50 or 100 volts, which enormously reduced the tendency to leakage. These were very important advantages in the series over the parallel system, an importance based on the great difficulty of proper insulation in the transformer system.

Mr. Atkinson favored the introduction of iron into the armature of the dynamo, but thought it a mistake to attempt to work the iron to the same degree of saturation as had been attempted in direct current machines. In the construction of multipolar dynamos it had been discovered that with more than six poles there was great difficulty in preventing the heating of the iron in the armature however well it might be laminated. A rough calculation which he had recently made of the number of lines of force which might be cut in an alternate current machine without danger of heating from magnetic hysteresis, showed that with a six pole machine run at a speed of 600 revolutions [per minute] about 14 lines to the square inch, was about the maximum such a machine could be operated; while with a 16 pole alternating machine, run at the same speed, and assuming no greater hysteresis from vicosity nine lines to the square inch would produce the same heat. This, he maintained pointed at once to a considerable reduction in the density of magnetic lines to be used in alternate current machines.

He also thought the use of a number of small machines, in the alternate system, preferable to that of one very large one, which, in case of a breakdown, would totally collapse.

J. E. H. Gordon, while appreciating the advantages of alternating current machines with which he had been prominently identified as an inventor, was yet so far convinced of the superiority of distribution by storage batteries that he was ready to adopt this system at the expense of abandoning every patent he held. He believed in the practical success of alternate current machines, and in their economy, as demonstrated by his own which had been in successful operation for the last two years, but he thought storage batteries were better and therefore he had determined to abandon this class of machines. Comparing small alternate machines with large ones, experiment showed that the large were better; he had tried to work alternate machines in parallel but it required three or four minutes to make them synchronize, and the "jumping" of large machines, during that time, might take a month's life out of 20,000 incandescent lamps.

For arc lamps alternate machines might be coupled in parallel, and small ones used, but for incandescent lighting, very large ones were a practical necessity, and they took up so much space, that practically they must be placed out of town and the current conducted in.

Two 16-inch direct current machines used in connection with storage batteries would do the same work as one 10-foot alternate current machine and occupy far less room. A plant such as his company was now constructing to supply 20,000 incandescent lights, would have ample space for engines, dynamos, and batteries in a room 40 x 86 feet, and a plant of about that size was more economical than a smaller one, while a larger one would require a *pro rata* increase of expense with the disadvantage of distributing at a greater distance from the center. Stations of 10,000 to 20,000 lamps with direct current could be coupled together, so as to render mutual assistance in case of accident. The alternate system required the investment of capital in boilers, engines, dynamos, and engine room of sufficient capacity to meet the maximum demand for light made on the plant during a certain limited time of about one and half hours in each 24, that is from 6 to 7:30 P. M. in winter; but during the remaining 22½ hours the interest on this capital continued, while the plant was comparatively idle; but with the direct current, storage battery system a much smaller investment would furnish the necessary capacity, since electric energy generated during the hours of minimum demand could be stored up to meet the maximum demand. Another important point was that the ratio of efficiency to economy in an alternate current dynamo was much greater when run at or near its maximum capacity than when run at lower rates of speed; furthermore, the number of alternations per second, whether with or without transformers, must be sensibly constant, the speed of the dynamos and engines being maintained at a nearly uniform rate whether giving full power or only a fraction of it. A compound engine working at full speed and at a third of its power, burnt twice as much coal per horse power as when working at its full power. But the smaller engines used for the direct storage currents could be coupled together; and in practice such engines are run at their full power till the necessary storage is obtained, and then stopped; which was far more economical than running big compound engines at half their power.

In large cities, the best site for a central station was in the immediate vicinity of large hotels, residence flats, and similar buildings, where the waste products of the plant, such as hot water and waste steam, could be utilized, thus converting an expensive nuisance into an important source of revenue, as has already been done practically.

Mr. Crompton said the lighting of the future would be monopolized either by the battery transformers or the alternate current transformer. He believed that with the alternate transformer system as at present arranged people were greatly dependent on their neighbors, an accident to a transformer, often affecting the light several blocks away, which could not happen with the direct current storage system. He had been at work on this subject for the last two or three years; admired Westinghouse and his wonderful work; said that the apparatus as it left his factory was well made, which might with equal truth be said of all the work done at American electric lighting factories, but that the putting up of the work in the various installations throughout the country was inferior to that of the English installations. The transformer system did very well where it could be carried over the tops of houses in a rough and ready fashion but lost its advantages when confined under streets. To talk of copper as if it were the only thing involved in the cost of conduction was nonsense. By taking 500 volts, which was workable for a distance of one to two miles from the central station, the cost of the two systems was practically identical, and there was no saving in the alternate sysem. The large engines, dynamos and transformers required by this system were wasteful in the extreme, especially the compound or triple expansion engine worked down to a fourth or fifth of its full output, as required by the peculiar conditions of electric lighting already shown. If alternate current machines could be run in parallel then the system could be used economically, but that had not yet been done successfully, and it was doubtful whether it could be done. And, till this was done, the advantages were on the side of the direct current storage battery system.

Electricity and Crime.

The relation of electricity to crime, which began with the invention of burglar alarm devices, has been extended in the shape of an electrical detective camera, invented by two Newark men. Their idea is to have the device fixed in the walls of banking houses behind the tellers, and so arranged as to photograph whoever stands at the teller's window, in case the man's picture is wanted. The little button that does the work of opening the camera shutter making the exposure, dropping the plate, and putting in a new

plate, will be under the teller's desk, so that he can, without betraying himself, instantly take the picture of any one who excites his suspicion. This same camera can be put up in police stations in the same way, and as the prisoners are brought in they can be photographed without knowing it and having a chance to distort their features as they do now when sitting for the Rogues' gallery.

Electrical Distribution by Means of Transformers.[1]

BY KENNETT D. MACKENZIE.

PART III.

It may be well to remark here that it has been found quite practicable to couple alternating current machines in parallel, so as to throw them in and out of circuit while current is on the line. Messrs. Zipernowski effected this some while ago, and I find that the Westinghouse Electric company also work their machines thus. Practically speaking, all that is necessary is to synchronize the dynamos, and while their alternations are thus synchronous they can be coupled together or disconnected at will.

I can not speak from much experience myself on this subject, having only experimented with some of Messrs. Siemens's machines. I found, however, that while it was possible to synchronize them and couple them in parallel, yet the slightest thing would throw them out of gear, if I may so speak, and destroy the balance. Even a small piece of waste falling on the belt was sufficient to do this.

With dynamos, however, having a large mass of iron in the armature, I believe it to be much more easy to couple them together, and this may be the reason why others have had more success than myself. The subject is an interesting one, and of great importance, I think, in large central stations employing alternating currents and transformers.

Until some practical means of electric storage, suitable for installations of this nature, be devised, the whole question of electrical distribution can not be said to be completely solved. In gas works plant can be laid down which will continually produce gas, which can be stored and drawn upon during the few hours in which the demand is greatest; but with electric lighting, if carried out on a large scale upon this system, it is necessary to furnish plant capable of meeting a maximum demand, although such demand may only exist during one hour in the 24. This necessitates the machinery standing idle during a part of the day, and consequently loss through unprofitable employment of capital; hence it is most essential that due care and forethought be exercised in arranging the number and sizes of engines and dynamos in any specific installation.

Two points now claim our attention, as they bear directly upon the question of the dynamo. Shall this yield a current of the potential required in the supply mains? In other words, shall it be a high potential and small current dynamo, or shall it be one which gives out a large current at a lower potential? In the latter case it will be necessary to pass this current through a transformer which will convert the electricity supplied into its required proportions, or, in other words, will raise the potential and diminish the current. In actual practice I do not believe that this application at present exists. I had the advantage of discussing the matter thoroughly in 1884 with Dr. Orazio Lugo, of New York, when he was in this country watching the early experiments of Messrs. Gaulard and Gibbs on the Metropolitan railway, and we made some experiments which led me to consider such an arrangement advisable in certain cases, and I have no doubt that before long it will be put into use in certain installations now in contemplation.

I am inclined to believe that this employment of potential-raising transformers, even with their attendant loss in the transformation of the energy, offers advantages over direct working, since the cost of construction of low potential dynamos is less than that of high ones, and greater reliability may be obtained, as well as more perfect control over the supply into the mains.

Upon this subject, however, makers of alternating current machines may be able to enlighten us more fully, as the questions involved apply more directly to details of construction in the dynamos. These main transformers can of course be equally applied, whether the other transformers be connected in parallel or series upon the supply mains.

[1] *London Electrical Review*, February 17th.

Waterhouse Electric Light Company.

The Hartford *Courant* has this to say of the Waterhouse Electric Light company of Hartford:

The Waterhouse arc system is in active demand and can be considered past the experimental age, for the company shows letters of endorsement, all attesting to the excellence of the light and apparatus, and plants have been installed in such concerns as Taft, Weeden & Co., Providence, R. I.; Whitin Machine company, Whitinsville, Mass.; Evans, Seagraves & Co., Blackstone, Mass.; Slater Cotton company and E. Jenckes Manufacturing company, Pawtucket, R. I.; Atlantic cotton mills, Lawrence, Mass. The large ferry boat Piedmont, plying between San Francisco and Oakland, has just been equipped with the incandescent lights of this company. The boat is one of the finest in the world. The systems of nine years ago were taking a horse power and a half per light, which was very unsteady. To-day the lights of the best systems show great improvement in steadiness and the power has been reduced to one horse power for a 2,000 candle power light. The various systems have been trying to break this record and accomplish it on paper by taking out the friction of engine and dynamos, giving the net power required, but in practice a nominal 2,000 candle power light of standard size usually takes a full horse power per light. This was not accomplished by the old systems, but by new ones, coming in three or four years ago. It has always taken a new system to lead the advance. Now, instead of one horse power for a nominal 2,000 candle power light of standard size, the Waterhouse is guaranteed at three-quarters of a horse power per light, and evidence is offered to prove it. This is a saving of 50 per cent. as compared to the systems of nine years ago, and 25 per cent. as compared to those of four years ago. The same economy is noticeable in the smaller lights. The store lights in Hartford are nominal 1,200 candle power, and a recent test in a station elsewhere developed the fact that 1,100 of the same lights required .652 of horse power per light. The Waterhouse company makes a light eight and one-half ampere, which is called by some companies 2,000 candle power, and which is a third larger than the 1,200 candle power lights, which are 6.8 ampere, and yet it takes no more power. But this is not all. Regulation of the current is the most difficult to accomplish and the most important part of a system. To run an electric light plant without a regulator is something like running a steam engine without a governor. The regulators of to-day are not many. The largest business has been done by the systems which have regulators. The electrician of the Waterhouse company, A. G. Waterhouse, has devised a highly ingenious system, by which the regulation is produced by automatic variations in the current, depending on the work to be done and preserving a nearly uniform current in the lamp circuit, whatever may be the number of lamps burning. A test of this regulation was afforded by running a 35 light dynamo with ammeters placed in the field magnet circuit, the lamp circuit and the local circuit. The field and local circuits unite and pass over the lamp line, which is thus the total of the two. The 35 light dynamo was running 20 lamps, and at that load only 4¾ amperes was passing around the field magnets and the balance of the current was passing to the lamp line by way of the local circuit. Five lamps were cut out and the current in the machine was reduced to four amperes. On cutting out five more lamps the current in the machine was 2¾ amperes, and with only five lights burning the current went to two amperes. Then all the lamps but one were cut out and the current fell to 1¼ amperes. The machine was cool, as only a small current was passing through it. But there was no visible change in the burning of the lights; because, as the current passing around the fields was reduced when lights were turned off, reducing its generating capacity, the current in the local circuit was increased in a like proportion, so that the amount of current on the lamp line was the same. It is reasonable to suppose the largest Waterhouse dynamo could be run with one light twenty-four hours or longer without heating. The Waterhouse arc lamp is a new invention. The light produced is remarkable for its steadiness, and it is said that no trouble is found in successfully competing with the best systems in use. The company is now adding machinery to again double the amount produced.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 7.—The New York factory of the Western Electric company, follows the example of the Chicago factory of the same company in moving from small leased quarters to a large building of its own, and shareholders have to thank a wise management for the fact that these changes are demanded by a constantly increasing and profitable business. The building at 70-76 Trinity Place has been occupied by the Western Electric company for eastern offices and factory for about nine years; it is owned by the Western Union Telegraph company, and was formerly used by that company as its general manufacturing and repair shop. The new building will be on the same street and distant only about a stone's throw further up town. It will be a nine story and basement building and will face 119 feet on Trinity Place and 85 feet on Thames street. Plans have not yet been fully worked out by the architects, but it is probable that the front of the building will be of light colored brick, similar to the telephone building on Cortlandt street, and that the offices will be on the upper floors while the factory and shipping department will occupy the other floors.

In recent issues of the WESTERN ELECTRICIAN were described the construction and operation of the most extension street railway in the world that at Richmond, Va., operated by the Sprague system. It is now learned at the offices of the Sprague company on Broad street, New York, that the road is running in the most satisfactory way. On Easter Sunday 9,000 passengers were carried, and each car traveled 87 miles.

Considerable uncomplimentary newspaper comment has been made about the action of the Western Union Telegraph company in making deductions from the salaries of its operators and other employees who were unable to reach their work on the three days last month when New York succumbed to the blizzard. The officers of the company explain that their employees insist upon extra pay for work overtime and that it is only logical not to pay when they do not work, but it is true that the Metropolitan Telephone and Telegraph company, which employs over 400 operators and clerks, and also the American Electrical Manufacturing company, both paid in full their employees who were detained by the storm.

The United States Electric Lighting company in fitting up the steamers City of Troy and City of Northam have used exclusively fire-proof wire manufactured especially for them by the New York Insulated Wire company. The Sawyer-Man Electric company will also use the Grimshaw wire in wiring the capitol at Washington.

The behavior of copper wire on long distance telephone and telegraph lines during the blizzard scored a mark in its favor, and Vice-President Rosner, of the Postal Telegraph and Cable company tells a story of the tenacity of copper line wire that is most instructive. He states that a farmer blew up with dynamite cartridges five of their poles that stood on his land, the farmer deeming that the company had not compensated him properly for the right of way. Notwithstanding the fact that the poles were used in this fashion the wires held to their places, and it was three days before the company discovered that anything was the matter. The result of the explosion so astonished the farmer that he declared that thereafter he would leave the poles alone.

Chas. A. Schieren & Co., report recent sales of their leather link belting to the following companies for use on dynamos: Paterson Electric Light company, Paterson, N. J.; New York Electric Construction company, New York; Delaware Electric Light company, Salisbury, Md.; Olean Electric Light and Power company, Olean, N. Y.;

and the Utica Electric Light company, Utica, N. Y.

The messenger boys in the employ of the district telegraph companies in Williamsburgh are all out on a strike this week, on account of the refusal of the companies to grant an increase in the boys' pay of from 2½ to 3 cents a message; at this writing business is nearly suspended, and the boys are engaged in drubbing such "scabs" as they can get hold of. The boys hope to succeed in this contest between labor and capital, and at their indignation meeting last night they voted unanimously to hold out until the last.

An interesting question concerning the liability of district telegraph companies is now before the court in the case of Jacobs Bros., clothiers, against the Manhattan District Telegraph company. It seems that Walter Duckworth ordered c'othing from Jacobs Bros., which they sent to him by a messenger boy, with instructions to bring back either the money or the goods. Duckworth accepted only a part of the clothes and returned the balance with a check for half of the bill. Jacobs Bros., declined to accept this settlement, and as the telegraph company refused to send the boy back to get the goods the tailors sued to recover the value of the bill. The company claims that it cannot be held liable as a common carrier, because it is incorporated under the telegraph act; that it does not do a C. O. D. business, and that the boys are not authorized to do a C. O. D. business and collect the money therefor. On behalf of the tailors it was shown that they had frequently sent boys with C. O. D. orders on occasions previous to the transaction complained of. Judge Steckler granted permission to counsel to submit briefs and reserved his decision.

General O. E. Madden is president of the Empire City Electric company, and E. W. Carritt, secretary and treasurer, is the active manager. They have two traveling salesmen constantly on the road and report business as most satisfactory in every department. The bills suggested at Albany for reducing telephone charges in New York and Brooklyn as the result of the telephone investigating committee's work, seem to be sleeping undisturbed in the assembly.

The board of electrical control require that all lamp posts used in New York must be of uniform height and make. They must consist of a hollow cast iron post, 11½ feet in length, 4 feet of which must be below the sidewalk, with a yellow pine column projecting 12½ feet up from the top of the casting. So that the poles stand just 20 feet above the sidewalk. Over a million dollars has already been expended on the New York subways, and a large amount of work is planned for the coming season. The question of building subways in Brooklyn is now agitated in that city.

Indianapolis Items.

INDIANAPOLIS, April 9.—The Atlas engine works of this city have just completed a 200 horse power engine to run the electric light plant at the Cincinnati centennial exposition. Several new and valuable features have been introduced.

At the meeting of the city council last Monday night, after any amount of discussion the following resolution was adopted. "That the action of the board of aldermen be concurred in and that the civil engineer insert in the advertisement that bids also be made for lighting alleys as well as streets, and laying wire underground in part or in whole; also, to bid for lighting the entire territory now lighted by the Indianapolis Gas company and the Vapor Light company: also, with proposition to sell to the city at the end of three years." The action of the board of aldermen referred to was given in last week's letter. There seems to be a determination on part of some members of the council to delay the question of light as long as possible. Several electric light companies are prepared to bid as soon as it is definitely known what the city wants, but none of them care to bid on a one year contract.

During the latter part of the winter the subject of an electrical railroad from this city to Crown Hill cemetery, Mapleton and Broad Ripple, a pleasure resort eight miles north, was again agitated and subscriptions came in freely. Now that there is a prospect of the Citizens Street Railway company building a line to Crown Hill to be equipped with electric motors, the former company have given up the idea of building. The street railway company has made a proposition to continue its line from Crown Hill to Broad Ripple over the proposed route and turn it over to the Ripple company for a certain sum. The building of the line depends on the action of council on an ordinance now before it.

Following is a clipping from the *State News:* The arc light branch of the Jenney Electric Light company of Fort Wayne, has finally determined to locate at Plymouth, Indiana. The company requires a donation of $15,000 in cash, ten acres of ground and a floating of $115,000 of the stock of the company. The citizens have with but little effort succeeded in raising this seemingly large requirement.

Geo. W. Shinn a railroad switchman, has brought suit against the Central Union Telephone company for $10,000 damages. Shinn was knocked from top of a moving train by a telephone wire strung across the railroad track.

M.

From the Pacific Slope.

SAN FRANCISCO, April 5.—A company has been organized and has obtained a franchise to operate an electric street railway by an underground circuit.

Fort Braggs and the Garden City Mill companies have installed electric light plants so that their mills can be run at night.

The Pacific Rolling mills have put in a large electric light plant.

The California Electric Gas lighting company have brought suit against G. H. Henzell and others to obtain damages and to secure an injunction restraining the defendants from putting in gas lighting apparatus infringing on patents claimed by them.

The Western Electric company of Chicago has obtained a judgment of $100 against G. H. Henzell. The suit was instituted to recover payment for elevator cables.

Samuel H. Taylor, resident agent of the Thomson-Houston company, returned from the east April 2d.

The Pacific Power company has added to its steam power plant three large Keith generators and is now operating thirty motors ranging from five to fifteen horse power. This is the third electric power company in San Francisco.

The electric improvement company has installed an American plant at Fredisburg's brewery, San Jose.

Santa Ana is now lighted by a Thomson-Houston plant. The same company has installed a plant at Pasadena.

S.

Missouri Notes.

KANSAS CITY, April 10.—The Western Union Telegraph company has begun an action against the American Electric Light company of this city, to enjoin the latter corporation from stringing wires on Independence avenue. It is alleged that the wires of the electric light company are being built directly under the wires of the plaintiff company. If a wire of the Western Union should break it would come in contact with the high current electric light wires, and as a consequence, the lives of the linemen in the employ of the telegraph company would be endangered. The Missouri and Kansas Telephone company began an injunction action against the same defendant, to restrain the latter from erecting or maintaining posts, poles, or wires on the same side of the streets upon which the posts and wires of the Missouri and Kansas company are constructed. The petitioners claim that the proximity to the electric wire renders theirs useless.

Ellsworth, is soon to have a complete electric light system.

G. D. Ensinger, of Stockton, has invented a dynamo cut-off, by means of which connection with the electric lights may be made or withdrawn instantly, and causing less strain on the machinery than the contrivance formerly in use. It is a metallic arrangement mounted upon a small wooden disk, which is fastened to the dynamo, and is said to be a valuable appliance.

A test of the electric light plant at Sterling, has proved eminently satisfactory. Four hundred and twenty-five incandescent lamps and six arc lights are lighted.

McD.

THE ELECTRIC LIGHT.

Pontiac, Mich., will soon have electric light for its streets.

A Mather plant of 150 lights is being installed in Milwaukee, Wis.

A Thomson-Houston alternating plant for commercial work is being installed in Milwaukee, Wis.

The city council at Montezuma has voted an appropriation to pay for electric light for its streets.

In the plant of the American Watch company at Waltham, Mass., 200 electric lights are used in winter. There are twenty-five separate departments, and each is connected with the main office by a telephone.

At a recent meeting of the Boston Electric club it was agreed that more attention should be paid to joints in electric light wires. It was asserted that some form other than the ordinary double twist joint was necessary.

The Westinghouse plant which has been installed at Salem, O., by the Salem Electric Light and Power company has given excellent satisfaction. The streets are lighted by 330 25 candle power lights. Twenty-seven miles of wires are used.

According to *Cosmos*, the filaments for the Seel lamps are produced by impregnating silk or woolen thread with a mixture of silicate of soda and gum arabic. The threads are then passed between the two heated cylinders, and lastly, are carbonized at a high temperature.

The coaches of the State railroads in Alsace have been lighted by incandescent lamps since the beginning of the year. Current is supplied by accumulators. The capacity of the batteries is 40 ampere hours. Each coach is lighted by 5 Seel lamps of 10 candle power. They are regulated by a rheostat placed near each battery.

The London Bishopgate Ward club recently adopted this resolution by a unanimous vote: "That, in the opinion of this club, the city of London should be lighted by the electric light, and this club further considers that no contract for that purpose should be entered into which does not give the ratepayers the power of compulsory purchase."

A press dispatch dated the 8th from Logansport, Ind. reads: The Logansport and Fort Wayne Jenney Electric Light company have settled their differences by paying William Dolan $10,200. Dolan retires from the management of the company here, giving place to Victor Leiter, who will have full charge of the plant. The city will be thoroughly lighted hereafter.

The armored cruiser *Galatea* is being fitted throughout with the electric light, the installation being that of Messrs. Siemens. Interesting experiments have recently been carried out in Simon's Bay to ascertain the distance at which the electric search light signals can be rendered legible. It was ascertained that Capetown, 20 miles distant, could be brought into communication with the fleet.—London *Electrical Review.*

W. S. Gilbert, in an interview in the *Pall Mall Gazette* says: "If I were asked for my opinion I should strongly recommend that the adoption of the electric light in theaters should be made compulsory by act of parliament. It always seems ridiculous to me that while the outcry about exits is chronic, no one thinks of striking at the root of the evil, which is the use of gas behind the stage, where all the materials are of the most inflammable nature. Very little danger can come of using gas in the auditorium, whereas, on the stage, it is a never-ending source of danger."

The De Khotinsky incandescent lamp, says the London *Electrician*, is now made of the following types:—From 5 to 200 volts, from 4 to 300 candle power, and to work at a consumption of from 5 to 2¼ watts per candle. These are said to be the only lamps which will work at so high a potential. The makers say that lamps of very small candle power are now being made for 200 volts. The life of the lamps is stated to vary from 300 hours at 2¼ watts per candle, up to 2,000 hours at 5 watts per candle. Since the month of August last there has been at work in Berlin an installation of 1,100 lamps at a potential of 150 volts.

THE TELEPHONE.

The Knickerbocker Telephone company of New York, has been incorporated by Henry E. Townsend, Chas. L. Cammann and Gustave Frank.

The Van Rysselberghe telephone system is to be adopted for a number of lines in Japan, and an order has been received by Messrs. Mourlon Frères, of Brussels, for all the material necessary to fit up one of the principal telegraph lines in that country for telephonic communication. A similar order has been given to the same firm by the Bolivian government. The railways of Greece are also going to apply the system for communication between the various signal boxes on their lines.

The United Telephone company of London obtained an injunction March 16th restraining the Equitable Telephone company from infringing patents of the plaintiff corporation. The defendant company in December, 1886, informed the United company that the manufacture of telephones would be commenced and invited the latter to inspect the instruments. The United company paid no attention to this notice but when the manufacture was well under way sought to prevent the work. The defendant company took the ground that the plaintiff corporation had forfeited the right to appeal to the law by its delay. The court took a different view and granted the injunction.

Don A. Palmer, electrician of the Town of Lake, Cook county, Ill., has just made his annual report of the fire alarm and telephone department to the president and board of trustees of the town. The wires cover a large district, reaching from 39th street, Chicago, to 83d street on the south, and from State street to Western avenue on the west, with wires to Grand Crossing, the water works, Hyde Park center, and to 35th street station. The town owns 271 poles valued at $2 each; 5,035 glass insulators with pins and brackets, valued at five cents each and 140 miles of number 9 wire on poles, at $40 per mile making a total of $6,393.75; also 60 street fire alarm boxes valued at $125 each or $7,500. The miscellaneous apparatus is valued at $8,921.50, making the total value of the property in the department $22,815.25, an increase over the preceding year of $1,558.50. The expense for rental of telephones was $935, a decrease since the last report of $160 and for salaries $2,160, a decrease of $660 during the year. The report is very satisfactory and makes a good showing for the able electrician in charge.

THE TELEGRAPH.

There were 14,573,607 messages sent over the London and Northwestern telegraph lines last year.

A Spanish paper announces that the government intends to let a contract for constructing a cable between Spain and the Balearic islands.

It is said that a contract between the Western Union and the Illinois Central has been practically closed for the construction of a first-class telegraph line from Dubuque to Sioux City and on all the branches.

The city of St. Louis has begun a suit against the Western Union Telegraph company to obtain $22,635. July 1, 1884, the Municipal assembly passed an ordinance fixing a license of $5 per pole on all telegraph and telephone companies using the streets of the city. The Western Union company refused to pay the license. The company has 1,000 poles in the city.

Before the invention of telegraphy the people of the Pacific slope did not learn of events in the eastern states for several weeks after they had transpired, and foreign news was months in reaching them. Even at the present time, with the steam engine, fast mails, etc., it would be about a week before they received New York news, and at least two weeks before events reached them, were it not for the telegraph. Now, however, it frequently happens that the San Francisco newspapers publish news from London and New York before it appears in the Atlantic coast papers. For instance, should something happen in New York at 5 o'clock A. M., at which time the New York papers have gone to press, it can be flashed over the wires to San Francisco in time for publication of the papers of that city, it being then only 2 A. M., San Francisco time. In like manner an important cablegram arriving in New York at the same hour can be sent in the same way. With this advantage of time in favor of San Francisco, it frequently happens that the Pacific coast papers "scoop" their New York contemporaries on eastern and foreign news.—*Globe-Democrat.*

Miscellaneous Notes.

The Boston Electric Club is taking measures to establish an Electric Exchange.

Accumulators are being introduced in Berlin in connection with central station distribution.

At the annual convention in Sandusky March 21st, the Ohio Gaslight association rejected a proposition to change the name of the organization to the Ohio Gas and Electric association.

Collector (some years hence)—"Twenty-five dollars, please." Widow—"Why, what for?" "Was not your husband struck by lightning last week?" "Yes, he was." "I am collector for the American electric trust. Twenty-five dollars, please."—*Omaha World.*

Distinguished burglar—"What do yer think o' this mean plan o' workin' gentlemen off by 'lectricity? Hangin' 's good 'nuff fer me, every time." Touts (unlucky horse jockey)—"Well, I dunno. The thing has its good points. If there's anything exasperates a man after his race is run it's the thought that he lost it by a neck."—*Judge.*

A recent dispatch from Rochester, N. Y. says: A violent snow storm began here late in the afternoon. While the snow was falling heavily several vivid flashes of forked lightning were noticed, each followed by peals of thunder. The electrical display lasted about fifteen minutes. After that the air became warmer and the snow turned into rain. The phenomenon has never been before noticed in this locality.

An Electric Aid association has been organized in Buffalo, and the following officers elected; President, Tracy W. Niles; vice-president, Samuel Stewart; secretary, J. H. McNally; treasurer, John Lapey; executive committee, the officers and F. Kitton, A. C. Terry, J. B. Slocum, A. J. Ferguson, J. T. Rooth, Miss N Morgan and Miss I. H. White; board of auditors, John A. Pferd, Joseph Maxwell and C. W. Sears.

Prof. Strickler has recently accomplished a difficult feat in photo-micrography. Using the electric coil as a means of illumination in miscroscopical work, he has succeeded in producing excellent photographs of living bacteria and other moving cells, among them being the white blood corpuscle of man. The photographs of the last distinctly show intricacies of structure whose existence has been denied by many biologists.

Among the suggestion given in the annual report of President Warren of the Boston University for the celebration of the anniversary of America is the following: "The establishment, under national or international auspices, of a permanent scientific station at the northern magnetic pole of the earth, the same to be telegraphically connected with the chief signal office in Washington and with all the meteorological signal systems and national observatories throughout the world."

Arthur V. Wiltsie and John M. Pollock, who are well known in New York electrical supply houses through their connection with the Newburgh Electric Lighting and District Telegraph companies, were arrested yesterday in Brooklyn and charged with grand larceny. They comprised the banking firm of John R. Wiltsie & Son, Newburgh, and on account of their failure the Newburgh Electric Lighting Co. was on Wednesday of this week placed in the hands of a receiver, Wm. D. Dickey. The plant of the company will probably be sold to pay its indebtedness, which amounts to about $71,000.

Central station distribution has been inaugurated in Bremen; the electric company acquiring the right of way over houses, under streets, or in any other manner, by the annuual payment of one shilling per lamp to the municipality; the light being furnished to consumers for .57 pence per 16 candle power lamp hour, besides the expense of lamps and installation. The 100 volt, parallel, direct system will be used for the supply; 10,000 lamps represents the capacity of the installation. Hamburg has also a small station comprising 1500 incandescent lamps and some arc lamps, and a much larger station has been projected.

"The New Orleans *Picayune* says. "Many of the phenomena of cyclonal storms must be due to electrical action, as they cannot be accounted for by any reasonable theory of atmospheric dynamics or wind force, and the question arises whether or not some method of electric repulsion to protect houses from tornadoes may not be devised. The men who have abandoned the foggy regions of mere scientific hypotheses to make practical studies of electricity, and have accomplished such enormous results in training it to industrial and economical uses, should give their attention to the protection of buildings and towns from these powerfully electrified meteoric forces known as tornadoes. The idea is full of valuable possibilities."

A patent solicitor, electric engineer and contractor thus sums up the present status of applied electricity: In the United States there are twenty-three electric street railroads in operation, and as many more under construction, representing two hundred and twenty-three miles of track in public use; a minimum of five thousand four hundred patents owned by electric light and power companies, relating almost entirely to improvements of detail constructions, the number rapidly increasing; four thousand three hundred and twenty electric light installations in operation under contract; while he does not know the number of incandescent electric lamps so far manufactured, but admits that it far exceeds one million.

Among the selenium cells constructed by S. Kalischer, three were found to differ from the rest in their behavior on exposure to light; the resistance rapidly increasing after undergoing a momentary decrease, and the cell returning to its normal condition only after remaining for some time in the dark. Copper and copper brass electrodes were used in these three cells. The conclusion has been drawn from the above phenomena that the cells in question contain a hitherto unknown modification of selenium, the conductivity of which decreases, instead of increases, under the action of light. It may be, however, that the effects are dependent upon the nature of the electrodes, as the remaining cells have electrodes of zinc, copper-zinc, or copper-platinum. Experiments have been made by M. Bellati and S. Lussana upon the influence of light upon the heat conductivity of selenium. They found the value 1:1.1 as the ratio of the heat conductivities without and with exposure to light.—*London Electrical Engineer.*

The possible outcome of the signal service no one can foretell. It was audacious to undertake to watch and outrun the tornado; and, by our telegraphic control of lightning, to preannounce the approach of the tempest. Shall we at some time go farther and control the tempest? It is no longer audacious to anticipate any marvel Gen. Hazen says: "While some form of electric energy seems an important factor in tornado action, yet this should serve to allay our fears of danger. If Franklin, by the simple device of the lightning-rod, secured immunity from lightning strokes, is it too much to expect that the genius of these later times will discover some method of warding off, or ameliorating, the dangers in this case? It may be that the time is not far distant when, owing to the gravity of the problem, we shall see experiments carried on at great cost looking to the dispersion of the funnel cloud by discharges of ordinance or explosives." It is far more likely that we shall find some way of controlling the electric energies and preventing their concentration in such terrific force. —*Globe Democrat.*

At the meeting of the London Physical society, Feb. 25th, Professor Ayrton read a paper prepared by himself and Professor Perry, giving the results of experiments performed to show the respective advantages to the consumer of the direct and alternate current systems. The result of 75 observations gave as the number of watts per candle 3.3989 for the direct current and 3.3955 for the alternate. The life of a lamp might be shorter with

the alternate current, but there were at present no reliable data on this point, and tables professing to give such data were mathematical rather than experimental; neither were there reliable data to substantiate the claim of greater durability with the accumulator direct current system. In a series of experiments made three years ago with white light it was found that the amount of light supplied by a direct current is represented approximately by the formula $I = a(V - b)^6$; I representing the amount of light, V the potential difference between the lamp terminals, and a and b constants, b being the lowest value of V at which the filament begins to be luminous.

At the late meeting of the Westtown Farm and Garden club, Farmer A. J. Harrison told his fellow members of his recent experiences with a sharper. There drove up to his house in a fine rig a young fellow of business-like appearance and address, who wanted to put an improved style of rod on his house for the purpose of introducing the style in that neighborhood. It was a newly patented rod, the stranger explained, constructed on newly discovered scientific principles that made it superior to every other kind. The astonishing efficiency and value of the new conductor was chiefly gained by discarding the old-fashioned slender tips or points and substituting at the top of the rod good sized balls made of a peculiar combination of metals, and which formed a most powerful magnet for drawing the electricity from the clouds. One of these balls on the summit of his house was warranted to draw all the lightning from the clouds for 500 feet in all directions, and the rod attached would carry it safely to the ground. During a storm at night the ball would act as an electric light, and would illuminate an entire farm with the brightness of day. The stranger said he would fit out Farmer Harrison's house with the cloud-pumping electric light apparatus for a nominal sum, so as to introduce the wonderful discovery into the neighborhood. "I heard his story all through," said Farmer Harrison to the club, "and then I told him I didn't need any electric light to read about such fellows as him in the newspapers, and that he'd better make tracks off my premises on the double quick, which he did."

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	400
Central Union	47	48
Michigan	78	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	70	72

Business Mention.

The Pratt Electro Therapeutic Supply Co., of Chicago has been organized for the manufacture and supply of all electro therapeutic appliances. The incorporators are: William A. Stanton, William LeBaron, Geo. H. Bliss, Harry P. Pratt and Henry S Stebbins.

Partrick & Carter, of 114 South Second street, Philadelphia, Pa., have recently issued a new catalogue covering telegraph, telephone and miscellaneous electrical supplies, construction tools and materials, cables, and electro-medical apparatus. The catalogue is well illustrated and as a whole is thoroughly characteristic of the firm that has been for 21 years before the public.

The Silvey Electric company have a 35 light machine completed for Ada and are waiting on the putting in of their engine to test the machine before sending it out. They are getting out a plant to go to the Cincinnati exposition and are building a 100,000 candle power light to go with it. But one light of this size has ever been constructed. That was by the Brush company for the British navy. One light of this size is equal to 50 lights the size that are used in lighting the city.—Lima O. *Gazette.*

A book of considerable interest to American electricians is the March, 1888, catalogue of the Woodhouse & Rawson Electric Supply company of Great Britain, Lim., 11 Queen Victoria street, London, Eng. The catalogue is complete in its illustrations of miscellaneous electrical apparatus such as bells, bell systems, annunciators, gas lighting attachments, electric specialties, dental and surgical apparatus, dynamos and motors for domestic and laboratory work, batteries of all kinds and supplies, telephones and insulated wires. No small number of pages is devoted to portable accumulators and the information given under this head will be of great interest to the purchaser.

We believe in protection, when it comes to a watch, says *Practical Electricity.* The question of a well-made practically perfect watch, has been solved, and any attempted distinct improvement in the internal construction of a watch, to avoid the effect of nature's laws, will be very short lived. What is wanted to-day in the business of time-keeping is protection for already perfected time-pieces, and not a revolution in the construction of time-pieces. The substitution of a new metal for an old one, simply because it is in itself "non-magnetic" is not going to solve the problem. There are other more important facts in physical science, which must be taken into consideration. We buy a watch for a lifetime—not for a day. We believe in the anti-magnetic shield—in protection for what has already been proved to be practically perfect, in the requirements of the science of horology.

Electrical Patents.

Issued April 3, 1888.

380,310. Telegraph Key. David R. Borland, Montreal, Quebec, Canada.

380,316. Railway Signal. J. Hamilton Farrar, Chicago, Ill.

The object of the invention is to provide a vibratory signal which is maintained in a constant state of activity to indicate a clear track and is only stopped when by the passage of a train the electric circuit in which the signal is included is broken

Claims 1 and 3 follow: "1. A railway signaling apparatus, consisting of an electric circuit, a rheotome having a lever armature, and a visual signal mounted on the latter."

"3. In a railway signaling apparatus, an electric circuit in which a section of the track is included, a rheotome lying in said circuit, an armature carrying a signal disk, a spring drawing said armature away from the pole of the rhoetome, and a lamp box having an opening over which the signal disk vibrates."

380,382. Electro Magnetic Signaling Device for Mines. Logan McKnight Bullitt and Oscar C. Greene, St. Paul, Minn.

380,394. Dust Proof Thermostat. Abraham S. Kissell, Chicago, Ill.

We give the last claim: "3. In a thermostat, a compartment provided with a single opening in the roof thereof, contact points projecting in said chamber, and a cover for said opening sliding upon said roof and larger than the opening therein, in combination with the thermostatic bar passing snugly through said cover, but loosely through said opening, whereby said bar may have a lateral flexure and carry with it said slidable cover."

380,409. Semaphore Signal Apparatus. Frederick Stitzel and Charles Weinedel, Louisville, Ky.

380,426. Telephone Transmitter. Moses G. Farmer, Elliott, Me.

We give first, third and fourth claims. "1. A telephone transmitter having a set of fixed electrodes with roughened surfaces, a comminuted conductor connecting said electrodes, and a diaphragm resting against said comminuted conductor."

"3 A telephone transmitter having rigid or fixed electrodes secured to the body of the instrument, in combination with a comminuted conductor resting directly on said fixed electrodes, and a diaphragm adapted to hold the comminuted conductor in place and vary the conducting capacity of the instrument as it is vibrated."

"4. A telephone transmitter consisting of fixed electrodes having roughened surfaces and comminuted powder resting thereon, with a diaphragm for holding said powder in place, and a retaining ring, as described, for adjusting the diaphragm to and from the electrodes."

380,427. Telephone Transmitter. Moses G. Farmer, Elliott, Me.

The invention consists in two or more perforated electrodes arranged in close proximity to each other within a mass of powdered carbon which is retained within by two metallic plates.

We give claims one and five. "1. A telephone transmitter having comminuted powder retained between two conducting plates, and two or more electrodes resting in the body of the powder between the plates."

"5. In a telephone, a retaining case or cup, in combination with two metal plates, one located in the base of the cup and the other resting upon carbon powder contained in said cup, with two or more electrodes embedded in the carbon powder, and a retaining ring adapted to hold the outer plate against the carbon powder."

380,430. Galvanic Cell. William Frishmuth, Philadelphia, Pa.

380,435. Electric Arc Lamp. August Harding, Oakland, Cal

380,437. Telephone. Warren D. House, Kansas City, Mo.

The first claim is as follows: "In a telephone, the combination, with a body of vibratory electrolytic material, of an opposite electrode and means for moving the two relatively to each other, the same portion of the electrolytic body being constantly in contact with said electrode"

380,438. Telephone. Warren D. House, Kansas City, Mo.

We give claims four and six: "4. A telephone provided with a body of vibratory electrolytic material located between opposite electrodes and in moving contact therewith.

"6 In a telephone of the kind described, an electrode consisting of an annulus of vibratory electrolytic material, a saturating material contained therein, and inclosing conducting walls."

380,469. Underground Conduit for Electric Railways. S. Arca Whipple, Detroit, Mich.

380,545. Arc Lamp. Camille Berton, Paris, France.

380,554. Secondary Battery. Nicholas de Benardos, St. Petersburg, Russia.

380,568. Electric Belt. Cornelius B. Harness, London, England.

380,589. Galvanic Battery. Charles E. O'Keenan, St. Cloud, near Paris, France.

380,594 Electrical Time Stamp. Charles A. Randall, New York, N. Y.

388,595. Electrical Time Stamp. Charles A. Randall, New York, N. Y.

380,610. Machine for Covering Wire with Layers of Different Materials. Jean T. Van Gestel, New York, N. Y.

380,620. Dynamo Electric Machine. Walter A. Crowdus and Henry M. Sutton, Dallas, Tex.

The invention consists in winding iron wire into the form of disks or flat rings and then binding them together at equal intervals by forming around them series of pole pieces of iron wire wound thereon at right angles to the first winding, and soldering or otherwise holding the whole together when finished. As many of these iron disks as are necessary to form the iron core of the armature are placed side by side with their wire pole pieces in contact and secured to the shaft. By the use of this construction a good ventilation of the armature is secured. Galvanized iron is used in the cores.

387,646. Electrical Signal Apparatus. John R. DeMier, Las Cruces, N. Mex.

380,647. Electric Signal for Railway Cars. John R. De Mier, Las Cruces, N. Mex.

380,655. Municipal Signaling. Morris Martin, Malden, Mass.

A portion of the operating key is retained in the box to indicate the exact location of the caller. Of the claims we give the sixth: "In a municipal signal system, the combination of an electric circuit, a main office or receiving station containing a receiving relay, a register, and an indicating signal, a series of signal boxes each containing a signal transmitting device, and also an independent hand operated circuit control ling device accessible from the exterior of the box, as described, said circuit controlling device being constructed and arranged to momentarily change the condition of the circuit when operated."

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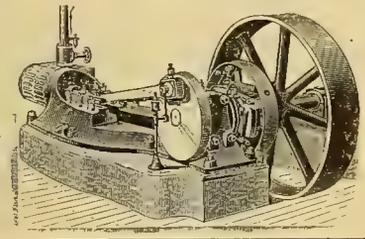

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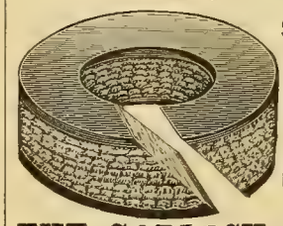

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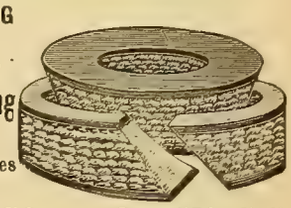

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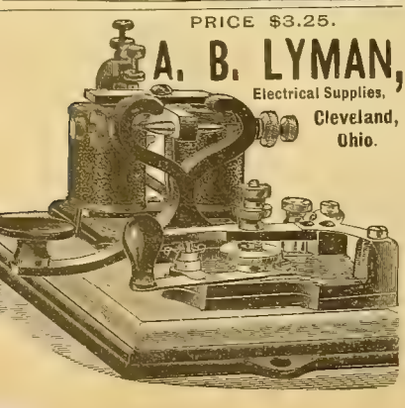

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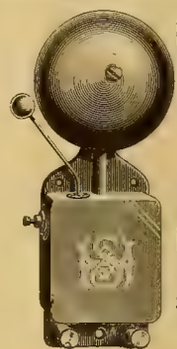

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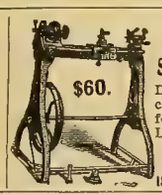

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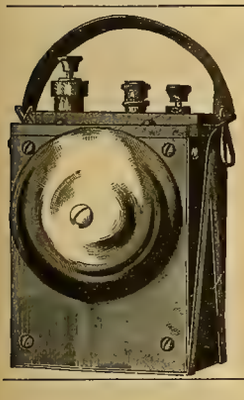

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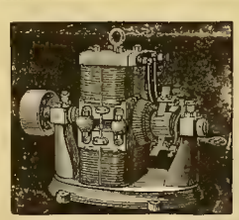

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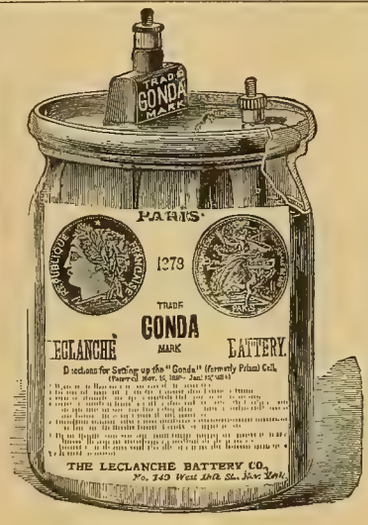

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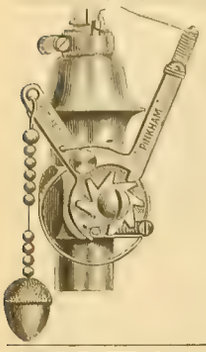

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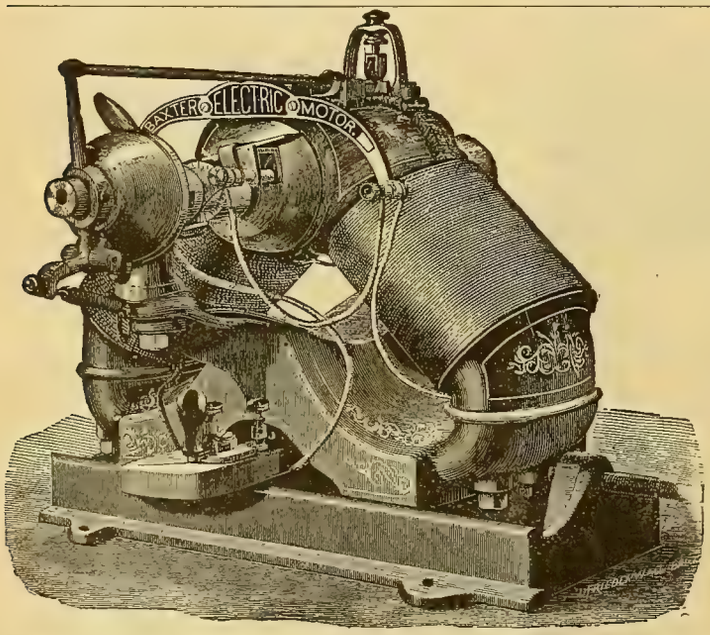

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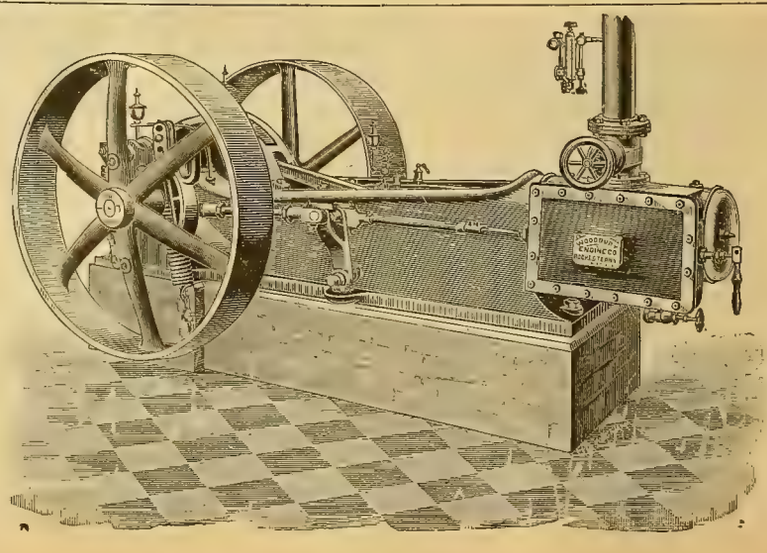

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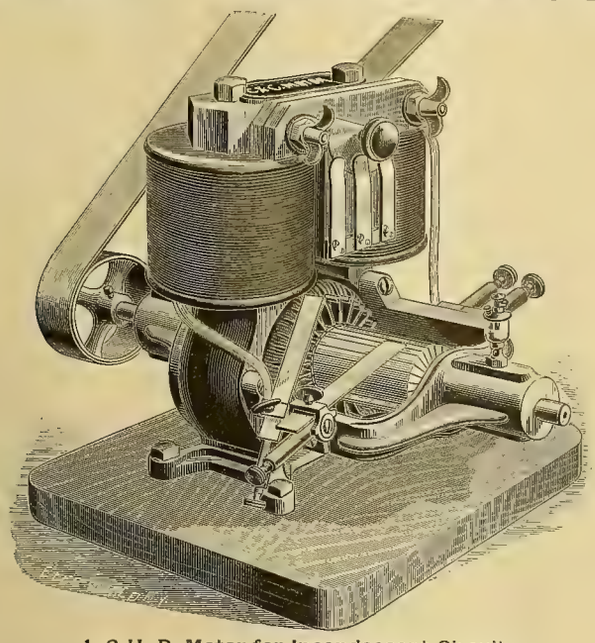

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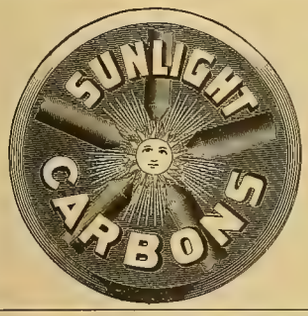

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What it is. Why so called. Why we use it for insulating wire. Why other manufacturers do not use it. What those who have used or tested it say.

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P. and B. is a compound which resists, completely, strongest Alkalies and Acids; it is a perfect waterproof coating and most perfect insulation. It is used largely by the leading Companies on Subways, Cables, Manholes, Wires, Connections.

Read the following letters:

Office of FRENCH ATLANTIC CABLE CO.,
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Your Compound has proved much more effective and as it is not affected by dampness or atmospheric changes. I am sure it would be of great value to those who require a superior insulating medium for similar purposes.

Yours very truly,
A. F. TOOVEY.

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Gentlemen:—We have used quite a quantity of your paint on the subway conduits so far laid, and it has given the best of satisfaction. We are now painting the inside of our manholes with it.

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THE KEYSTONE LIGHT & POWER CO.,
M. R. MUCKLE, Jr., Sec. & Treas.

Gen. Office of the
SAN FRANCISCO & NORTH PACIFIC R. R. COMPANY,
410 Mission St., San Francisco.
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Dear Sirs:—Referring to the piles covered with canvas and P. & B. Paint, and driven under our wharf at Tiburon, twenty-six months ago, I have had one of the piles removed last week, and found both canvas and paint in a good state of preservation and the pile entirely free from any signs of teredo.

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We have been unable to find any kind of wood that will last over eighteen months if unprotected.

Yours truly, H. C. WHITING, Supt.

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We use it for insulating wire, because, after eighteen months test, we came to the conclusion that it was by far the best insulation that had ever been used.

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THEY CANNOT USE P. & B. COMPOUND FOR THE PURPOSE OF INSULATING WIRE. By special arrangement with the manufacturers we control the sole right to use it for that purpose. Nearly all the large Manufacturers of insulated wires have applied for this right but found they were too late. We have the "documentary evidence to prove this," and may use it later on should occasion demand.

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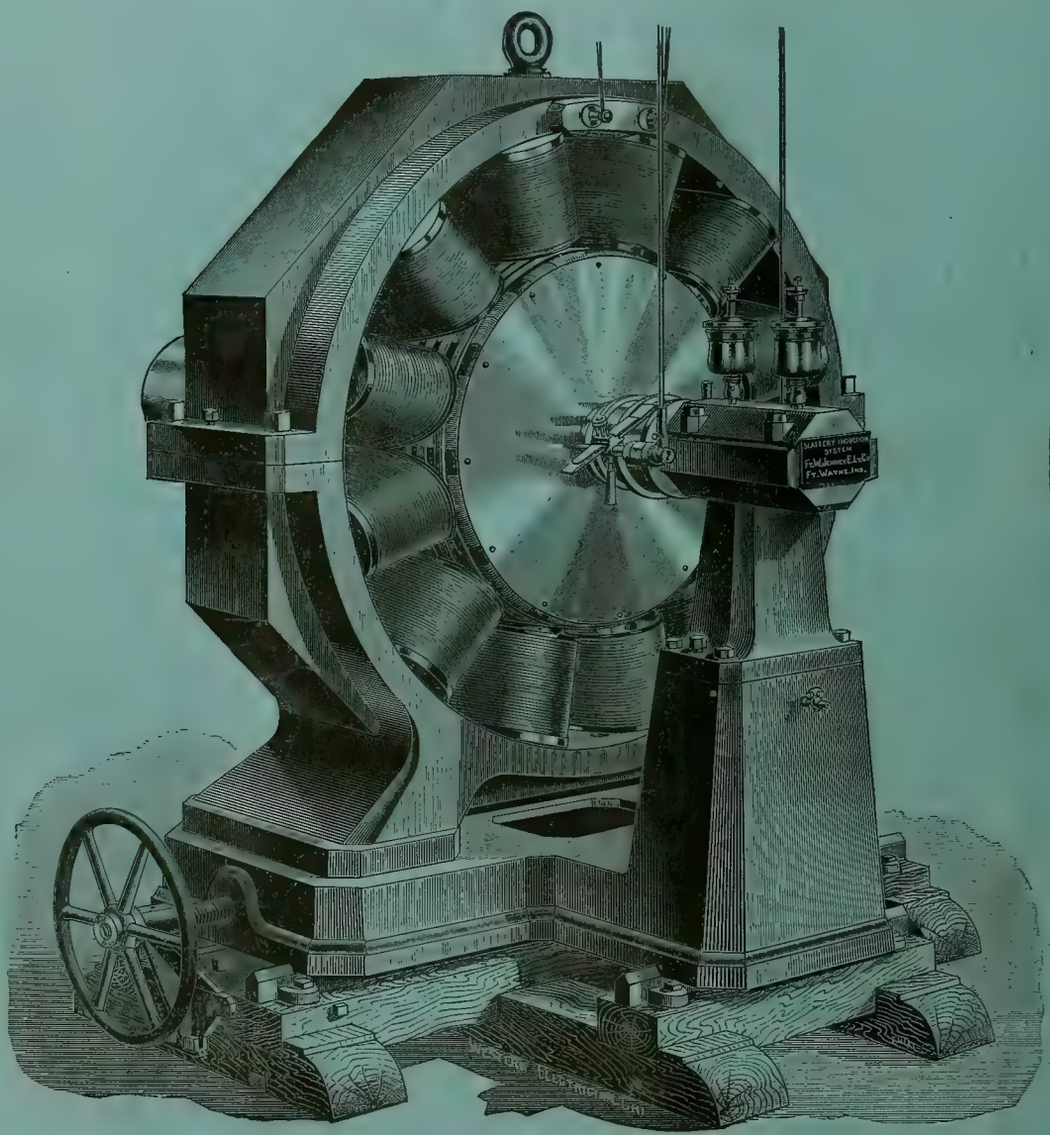

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Vol. II. CHICAGO, APRIL 21, 1888. No. 16.

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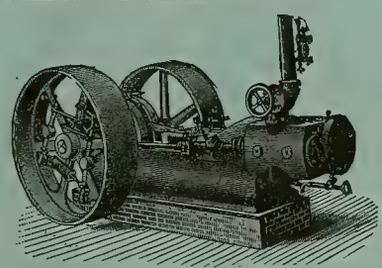

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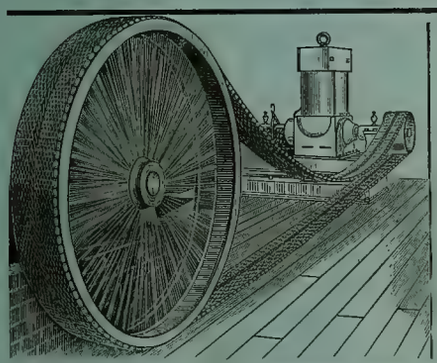

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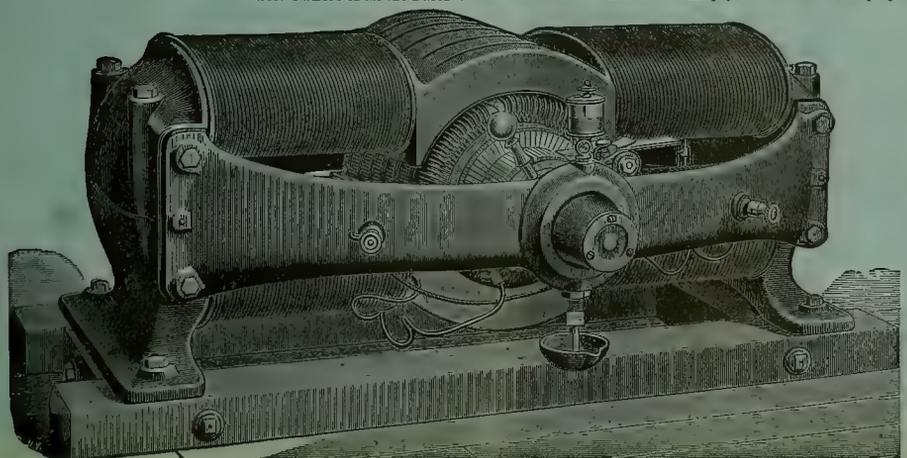

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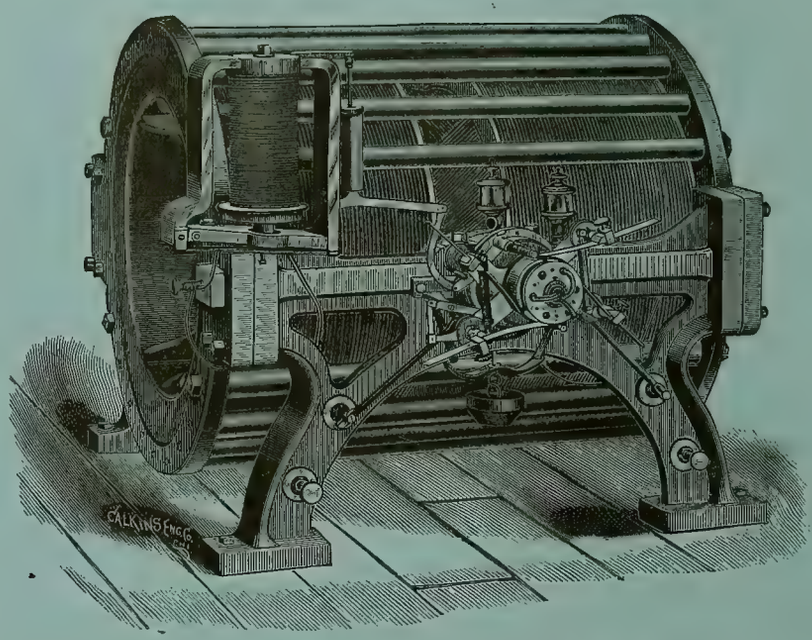

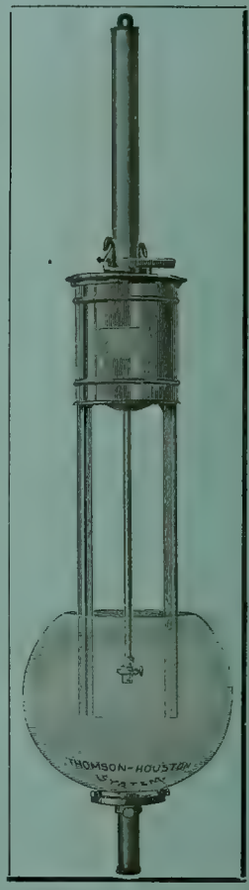

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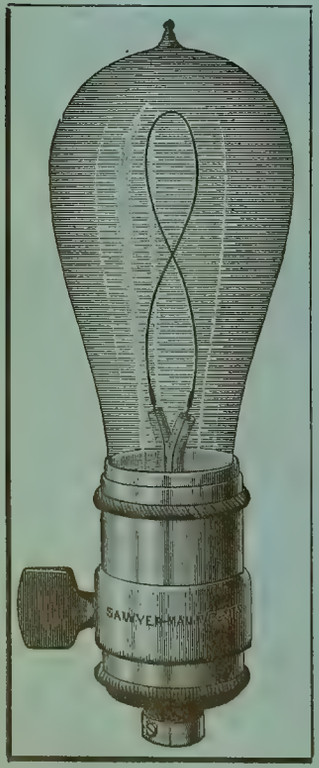
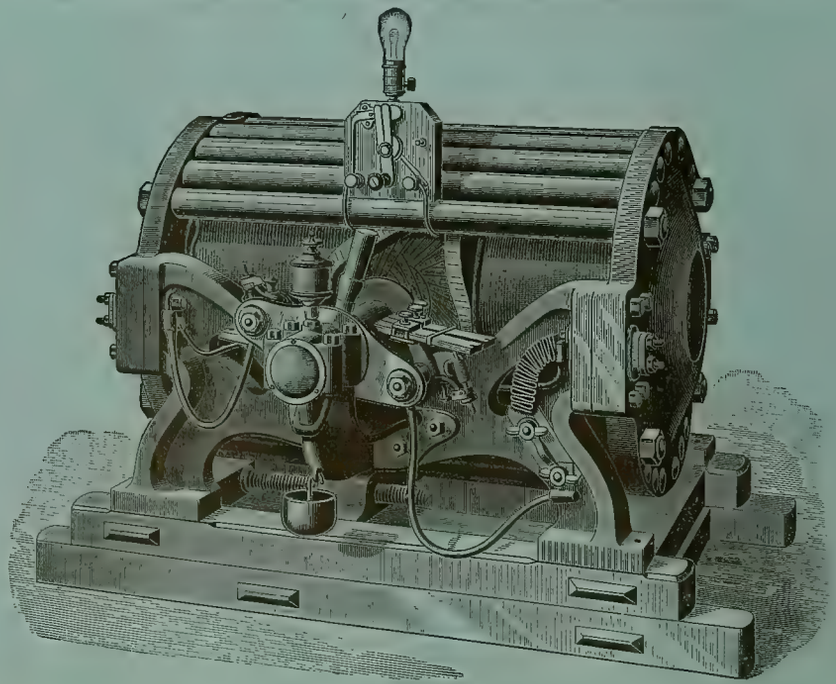
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

Chicago & Northwestern R. R.

Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.
G. H. Thayer, Sup't.

Chicago, March 13, 1888.

Leonard & Izard, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(signed) G. H. Thayer, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

Grand Opera House

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

Edison Plant was Rejected and Put Out,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{60}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS. FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN Manager. 216 LA SALLE ST., CHICAGO.

The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL

For information relative to Central Station Business, apply to the

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16 & 18 BROAD STREET, NEW YORK.

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MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

JARVIS ENGINEERING COMPANY,

61 OLIVER ST. BOSTON. | 81 LAKE ST., CHICAGO. | 109 LIBERTY ST. NEW YORK.

H. A. GLASIER, Manager.

CONTRACTING ENGINEERS FOR ERECTING COMPLETE STEAM PLANTS FOR

Electric Light and Power Stations

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ARMINGTON & SIMS ENGINES. NATIONAL FEED WATER HEATER, JARVIS BOILER SETTING, to burn Anthracite Coal and Coke Screenings NATIONAL ROCKING and SHEFFIELD GRATE BARS.

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THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

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For the Electric Light, Telephone and Telegraph,

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FOR ELECTRIC LIGHT AND POWER.

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Sawyer-Man Electric Co.

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SAWYER-MAN ELECTRIC COMP'Y. TRADE MARK SYSTEM.

Philadelphia Office:

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BOSTON OFFICE:

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

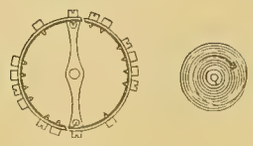
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**

These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

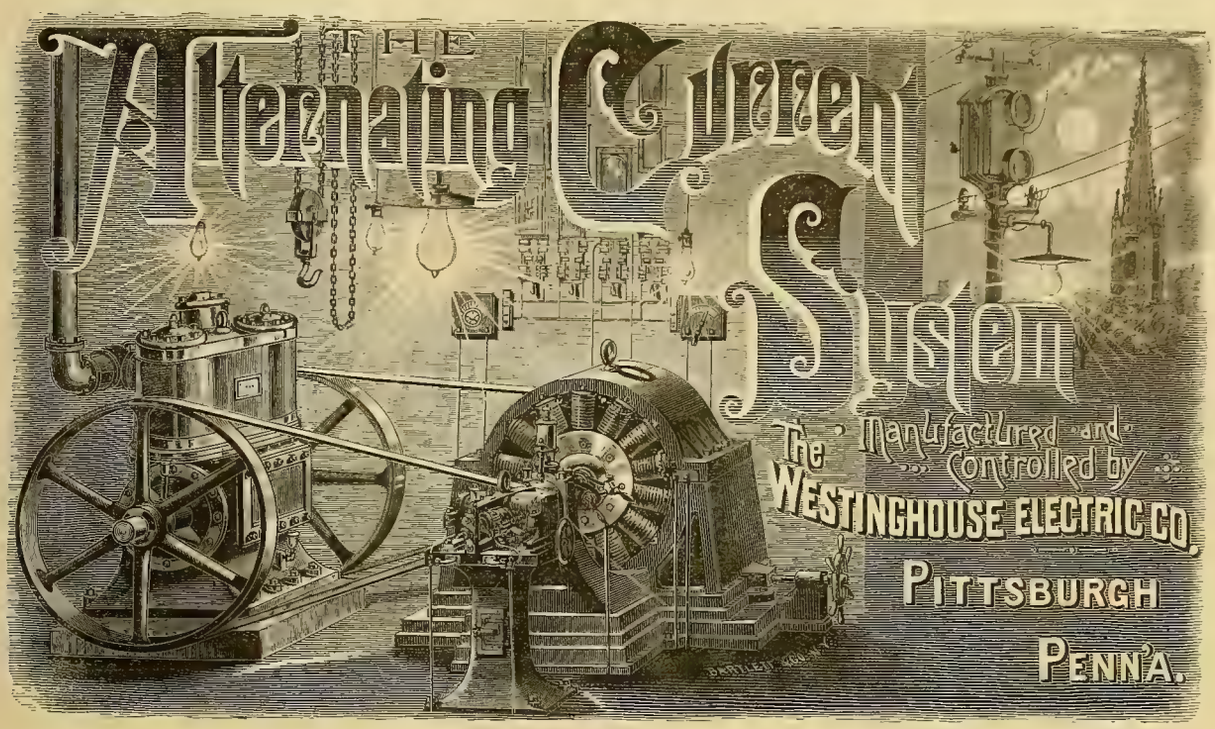
These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

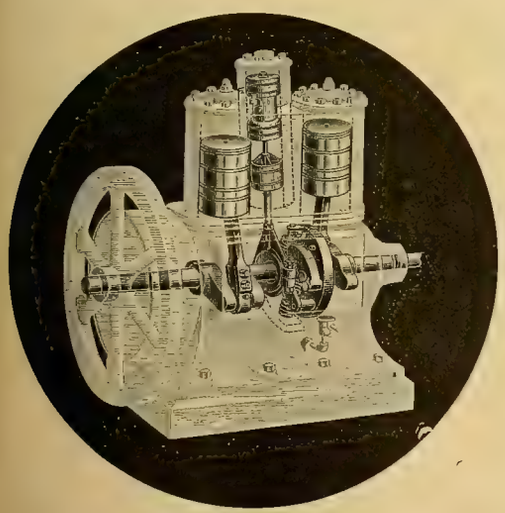
They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

For Sale by all First-class Jewelers.





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SHAFTING { Costs to Purchase / Costs to Maintain / Costs to Lubricate / Costs to Drive } VERSUS THE Westinghouse ENGINE.

Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

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With houses in Panama, C. A., Lima, Buenos Ayres, Guayaquil and Valparaiso, S. A.

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WE CARRY A FULL STOCK OF J. H. BUNNELL & CO.'S TELEGRAPH INSTRUMENTS.

Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

WESTERN ELECTRIC COMPANY,

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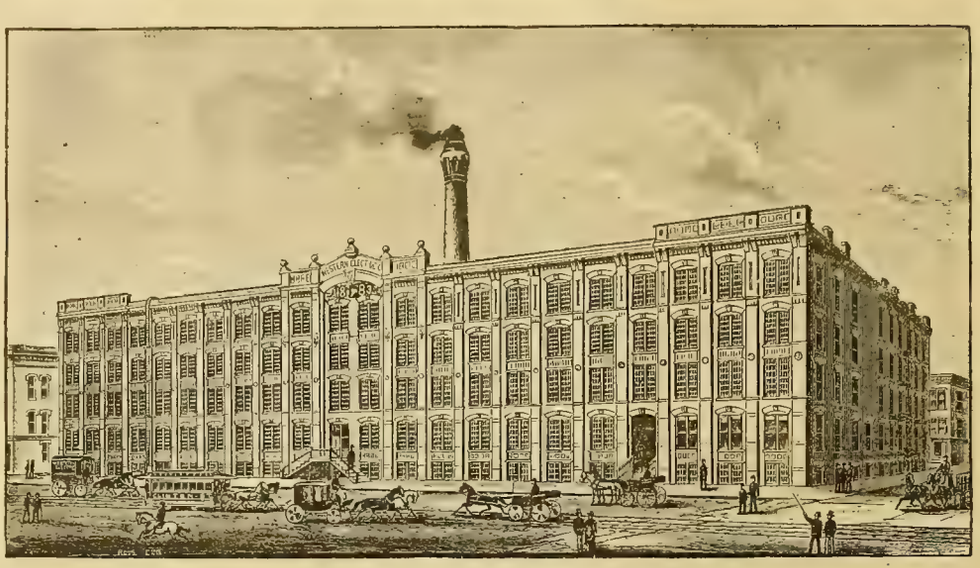


CHICAGO FACTORY.

Disque LeClanche Battery.

Western Electric Co., Chicago, Ill., April 10, 1888.
Chicago, Ill.

Gentlemen: Replying to your inquiry of this date, I would say, I have kept a record of the service we get from many of the Disque LeClanche porous cups furnished the Chicago Telephone Company by you since September, 1884. Without going into the minutiæ of this record I will state that it shows that we have had batteries in use which have been in CONSTANT SERVICE for about THREE YEARS and EIGHT MONTHS, and that the AVERAGE SERVICE which we get from porous cups of your manufacture is OVER ONE YEAR and SIX MONTHS.

Our inspectors are instructed to replace porous cups as soon as they show signs of failure, and many of the porous cups brought in as having been used up are still in fairly good condition and would give good service in places which do not require the work from a battery which telephone service requires.

Yours very truly;

J. J. NATE,

Purchasing Agent Chicago Telephone Co.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, APRIL 21, 1888. No. 16.

Electrical Alarm Clock.

A large part of the community is obliged to rise at a certain time each morning. Most persons who are under this necessity have experimented with alarm clocks and have found them wanting. To provide a reliable means for arousing the soundest sleeper the electric alarm clock, manufactured by the Dennison-Hall Manufacturing company of Chicago, has been put on the market. The inventor happened to learn that employes of street car companies had formed themselves into clubs and had hired night watchmen to arouse them at a certain hour in the morning. The cost was a dollar a month for each man. It was found that the ordinary alarm clock was not to be depended upon. It is a notoriously bad time-keeper as the alarm spring jars the mechanism; it frequently fails to sound the alarm and often its music ceases before the sleeper wakes.

These defects seems to be overcome by the new clock which is simple but ingenious. The clock and the battery are inclosed in a case as shown in the cut. The clocks are manufactured for the company, and are said to be excellent time-keepers as they are not subjected to the jarring of alarm mechanism as in ordinary clocks. By a simple device they can be set so that the magneto bell will ring from five minutes to any required period and the switch must be turned before the ringing ceases. Among the advantages of the clock mentioned by the company are the following: The alarm is so easily set and turned off that it can be readily employed for an indefinite number of purposes. Persons, for example, in the suburban towns set it so that a warning may be sounded at the time it is necessary to start for their train. If it was necessary to wind up the alarm spring each time and to allow it to run down in each case no one would take the trouble to use it. The clock and battery are in a compact form. The clock has only been put on the market within a short time but already a large number of railroad men have purchased clocks and they are advertising it by their recommendations.

An Electrical Trust.

A dispatch from Philadelphia says that at the meeting of the trustees of the Electrical Trust of that city a proposition was submitted for the formation of a national electric lighting trust. It was proposed, the dispatch says, to consolidate all the electric lighting companies in the United States in a trust so as to control all the electric lighting in the country. Propositions have been made to purchase all the certificates of the trust in Philadelphia, and there is ample capital behind the scheme to carry it out if a satisfactory deal can be made. It is said that the electric lighting franchises of several of the large cities of the United States have already been absorbed by this new trust syndicate, and the chances of the absorption of the Philadelphia trust are excellent. The scheme does not contemplate the purchase of the franchises of companies in the small towns, but only of those in such great centers as New York, Boston, Philadelphia and Chicago. There is reason to believe that the syndicate controls the electric lighting companies in New York and Boston, in which two cities the scheme originated. The propositions made to the trust in Philadelphia are based upon its net earnings for the past six months. None of the members of the trust were willing to discuss the details of the proposed deal yesterday.

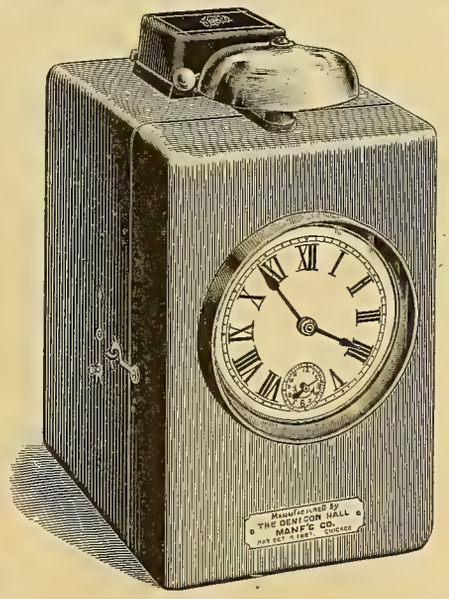
A later dispatch from Boston stated that officers of electric lighting companies in Boston professed ignorance of any intention of a syndicate to control the electric lighting of the great cities. They were inclined to consider the report incorrect.

In Chicago it seems to be the impression that there is a good foundation for the report. It is believed that a syndicate which has unlimited capital desires to control the franchises for both gas light and electric light. Then it is supposed that illuminant will be furnished which will be the cheaper to provide.

Death of G. E. Sutton.

Brief mention was made in the last issue of the death of G. E. Sutton, an employe of the Western Electric company, by falling down an elevator shaft in the works at 227 South Clinton street, Chicago, the evening of April 10th.

Mr. Sutton was a young man of much promise. He was nineteen years of age, had received the benefits of training at a technical



school and had secured a position with the company for the purpose of gaining a practical knowledge of the business,—an opportunity, by the way, of which he had been availing himself to the utmost.

He was a nephew of James B. Speed, of Louisville, Ky., president of the Ohio Valley Telephone company and at the age of twenty-one, had he lived, would have entered upon the enjoyment of an inheritance of large proportions.

Mr. Sutton was the only son of a widowed mother and to her was all that a dutiful son should be. She came to Chicago the Saturday preceding the Tuesday that he met his death, to establish a home for him—a home that death so rudely entered in three short days. The blow to the mother was exceedingly severe, and her grief was touching in the extreme.

Colonel Speed came from Louisville and Wednesday of last week, accompanied by the sorrow-stricken mother, took the body of the son to that city for interment.

Lafayette Electric Road.

The Sprague Motor company has received through its western agent, C. M. Barclay of Chicago, the contract for constructing an electrical railway for the street railroad company at Lafayette, Ind. The road will cost $48,000 and will be completed about June 1st next. The road will be about four miles in length.

Paris Theater Commission and the Electric Light.

The last meeting of the superior commission of theaters at Paris was devoted almost exclusively to the consideration of installations of electric lights in places of amusement. The subcommittee, composed of Messrs. Girard, Duprez, Mascart, Krebs, Vaillant and Guichar, presented a full report giving the results of a series of experiments which proved conclusively that when the electric light was well installed danger of fire absolutely disappeared.

The committee found that the most improbable circumstances must combine to cause a fire if the work had been properly performed. The experiments will be performed again before the commission. Among other important matters it was decided that the lamps could be supplied by means of accumulators with two circuits. M. Duquesnel observed that as electric light was the best illuminant for the safety of the people, the theaters should be given every facility to establish the system; they should be permitted to obtain the electric current from central stations as the majority of places of amusement had no facilities for placing engines and dynamos. The commission expressed the hope that the prefecture of the Seine would permit the theaters to run wires through the underground conduits.

Gibson Storage Battery.

Following is a description of the Gibson storage battery: The plates are made by fixing peroxide of lead in perforations in a lead plate. In the ordinary "grid" form of storage-battery plate the holes are of an hour-glass form,—smallest in the middle,—the contraction preventing the plug of active material from falling out. This has the disadvantage that the pressure caused by the gradual corrosion of the grid has a tendency to break the plug in the middle and force it out. To remedy this, M. Godot invented a plate in which the hole was largest in the middle and smallest at the surface. The objection to M. Godot's plate is in difficulty and cost of manufacture. In the Gibson form the holes go square through the plate; in them are put capsules of peroxide of lead in the form of a paste. The capsules only fit loosely in the holes, and extend beyond the surface. Plates thus prepared are passed between rollers set at such a distance apart that they press the capsules to the level of the surface of the plate, at the same time flattening the lead slightly, and causing the edges to overlap the holes, thus keeping the active material in. The method seems a decided improvement over that of M. Godot to accomplish the same purpose; very possibly, if tried with the best possible form of plate, it will be an improvement on the ordinary "grid" type. It hardly seems probable, however, that it will improve either the efficiency of the battery or storage capacity, although it might increase the rate of discharge and the life of the plate.

Electric Railways for Chicago.

It is possible that Chicago may soon see several electric street railroads. The officers of all the companies are interested in electric motors especially those which are soon to construct new roads. They have carefully investigated the several systems and in many instances they have

employed engineers to report on the workings of roads which are now in successful operation. Pullman in all probability will soon have an electric railway five miles in length.

A gentleman who is in a position to speak somewhat authoritatively said to a representative of the WESTERN ELECTRICIAN, "That Chicago will have electric roads soon is undoubtedly true. All the cross town roads can easily be operated by electricity. I don't know how soon the difficulties can be solved but a way will be found when the time comes."

Pumping Mines by Electricity.

At St. John's colliery, Normanton, England, is a new pumping plant operated by electric motors which far exceeds in magnitude any enterprise of the kind previously undertaken. At a vertical depth of about 900 feet there comes in a stream of salt water having a flow of about 5,100 gallons per hour. This water is raised at one lift at a rate of 7,200 gallons per hour, allowing the pumps a rest of 6 hours in the 24. The pressure on the ram faces being about 400 lbs. to the square inch, both pumps and electric plant required special adaptation. The pumps are differential, two 6 inch and two 4½ inch rams, and when doing full duty are run at 25 revolutions per minute. A preliminary trial with a smaller plant having showed that the load varied greatly at different parts of the stroke, it was necessary to devise a field and armature specially adapted to this condition to avoid the heating which would be entailed in an ordinary motor, operating under a large current with a regular and rapid variation of intensity. The current averages 66 amperes, but varies not less than 10 amperes above and below a mean. The heating effect of a varying current, according to Blakesley, is not proportional to the square of the mean current, but requires the addition to that of half the square of the variable part; and the rapid variations largely increase the heating effects due to hysteresis, and Foucault currents. The tension on the dynamo terminals is 600 volts, and on those of the motor, 575. The water, raised at the rate of 120 gallons per minute through 900 feet, represents nearly 33 horse power. The output of the dynamo is 53 horse power. Hence, the efficiency beween useful work and output of dynamo is $\frac{33}{53}$, equal to about 62 per cent. The ratio of useful work to belt power in dynamo is estimated at about 50 per cent. including all losses in dynamo, leads, motor, gearing, pumps and rising main pipes. About 2½ horse power is lost in cables and 13½ absorbed by the gearing and pumps, and by the friction of the water in the pipes.

To accomplish the same work by compressed air, it is claimed that the highest efficiency of the pneumatic system would not exceed 25 per cent., or about half that of the electric. The cost and maintenance of steam engine, pumps and main are the same in both cases, and also the losses in these items; and the items to be compared, both for cost and maintenance, and losses are, in the electric, the dynamo, cables and motor, and in the pneumatic, the compressors, supply pipes, accumulators and air engines. It must also be considered that cables conveying electricity cost less than pipes conveying air, can be more cheaply and rapidly laid, and are more secure against accidents, and more easily kept in repair.

The motor for this plant weighs 3½ tons, and the dynamo, 4 tons. The armatures, 24 inches in diameter and 16 inches long, are of the cylinder type, with massive commutators and substantial brushes and holders. The machines, wound according to the Immisch patent, run practically sparkless under a load varying 30 per per cent. at every revolution of the pump. The speed of both dynamo and motor is 430 revolutions per minute.

Electric Street Railroad at Davenport.

The Central Street Railroad company of Davenport, Ia., has closed a contract with the Sprague Electric Railway and Motor company through the western agent, C. M. Barclay, by which an electric plant will be installed on the line. The plant will cost $42,000. Eight cars will be equipped and according to the contract six will be running by July 1st next. The company has purchased a lot 60 by 80 feet for the generating station. The dynamo will be driven by two Corliss engines. Each car wil be lighted by six incandescent lamps. It is expected that work on the line will begin at once.

The Bonta Telephone.

J. W. Bonta, of Philadelphia, said recently in speaking of his telephone: "We expect to have a fight. "We think we can talk further than the Bell people and more clearly. Yet we understand well enough that when we go into competition with such a company, especially when we are to offer service at less than half their rates, there will be a hard fight against us. As we have $250,000 already subscribed as a campaign fund the fight may begin at any time."

In describing a test of the invention the New York *Times* says:

"Mr Bonta did not stop with scientific demonstrations. He set up a telephone and invited his callers to talk over it in gentle tones. He said there were five miles of wire between it and the other end. The conversation was usually begun by himself to set the tone. He didn't even take the trouble to stand near the telephone, but lounged easily three or four feet away and talked as quietly as if the person addressed were standing beside him. When the visitors found that they could do it as easily as the inventor of course they were charmed. Instead of the customary: What's that? What? Speak louder! Spell it! those conversing could talk in whispers if they chose."

The Keely Motor Mystery.

It looks as if Mr. Keely's cat would soon be out of the bag. A dispatch of recent date says: "Keely's secret of the manipulations of his mysterious motor, which he has guarded so securely for many years in spite of the efforts for disclosure made by dissatisfied stockholders of the motor company, is at last to be divulged. Yesterday Judge Finletter handed down the opinion of the court in the suit brought by Bennett G. Wilson, who claims to hold an assignment of Keely's motor invention, made to him in 1869, which grants an order for the inspection of all the motor machines made by Keely, and compels him to explain the theories of their workings to Wilson and such experts as may be named within a few days."

Thomson-Houston and the LaSalle Street Tunnel.

In No. 13, Vol. II, of the WESTERN ELECTRICIAN, mention was made of the electric service of the North Side Cable company in Chicago. The illustrations in connection serve to give a clearer idea of what the main part of that service consists and will prove interesting from the standpoint of the electrician or the layman. In preface an allusion to the cable plant is necessary. The main system of street railways on the north side in Chicago has recently been converted from traction by horses to traction by cable. As the Mecca of a large proportion of north side residents is a section of the city just south of the river it was found necessary to provide means for passing the river. This has been accomplished by utilizing the LaSalle street tunnel, a view of which taken from Randolph street, on the south side of the river is shown in Fig. 2. Cars coming from the north are upon the left track shown in the view; they pass directly south to Monroe street then east to Dearborn then north to Randolph, west to LaSalle and then north through the tunnel upon the right track shown in the engraving.

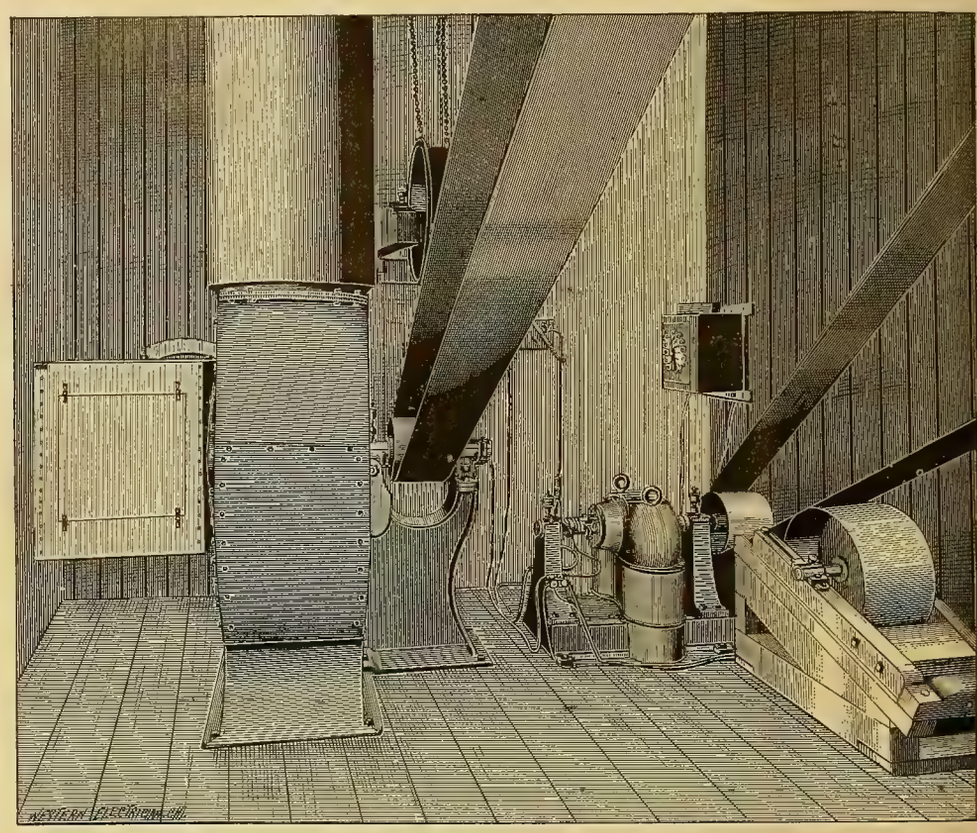


FIG. 1.—THOMSON-HOUSTON MOTOR AND VENTILATING FAN.

Originally this and the Washington street tunnel were constructed to give those desirous of crossing the river an opportunity to do so at any time without delay, for the bridges of Chicago are notorious for the delay to which they subject the people. But the tunnels were never popular. In summer and winter alike they were avoided on account largely of their coldness, in a measure their dampness and in part on account of the fear excited in timid persons that they might cave in and drown the wayfarers within. A very good proof of the unpopularity of the LaSalle street tunnel in particular, is found in a report of a count of the number of persons that crossed Clark street bridge, one block east of LaSalle street tunnel in 12 hours, from 7 A. M., to 7 P. M., one Saturday about a year ago. It was found that over 64,000 persons crossed over the bridge and that less than 5,000 persons went through the tunnel in that time.

With the cable line passing through the tunnel the latter promises now to become popular.

But to make the tunnel inviting, or at least to rob it of features objectionable to many persons, recourse was had to the electrician's art, as exemplified in the Thomson-Houston lighting and power systems. With the aid of the former, the

tunnel is thoroughly illuminated and, with the aid of the latter, the tunnel is thoroughly ventilated.

The dynamos, shown in Fig. 3, are in the power generating station at the corner of Illinois and LaSalle streets. The dynamos, driven by an independent engine, are at the north end of the main power room, and, as will be seen by the cut, the space at command is more than ample for the purposes. The room is light and airy and is kept in such a state of cleanliness that the most particular housewife could find no fault, however small. The larger dynamo, seen in the cut, is a Thomson-Houston 50 light machine. By it, the 40 arc lights in the tunnel and 6 distributed inside and outside of the station, are supplied with current. The lamps are 2,000 candle power and take 45 volts and 9.6 amperes per lamp. The dynamo runs about 20 hours a day, from about 6 o'clock in the morning until 2 o'clock the following morning. The load up to 40 lamps is therefore constant a large proportion of the running time, for the lights in and around the building are, of course, extinguished during the day time. Notwithstanding its nearly continuous duty, the arc light machine runs in a splendid manner without heating at any point.

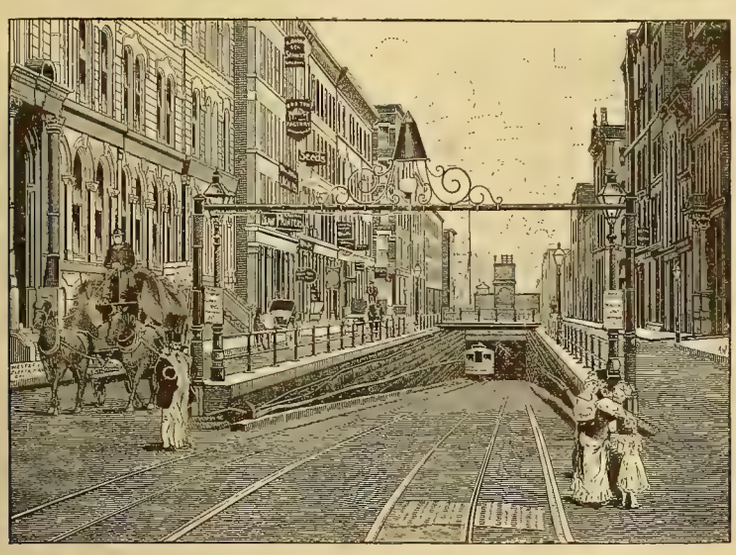


Fig. 2.—LaSalle Street Tunnel Illuminated by Thomson-Houston Arc Lights

The 40 lights in the main part of the tunnel, or that part through which the cars pass, thoroughly illuminate it.

The dynamo shown in the foreground in Fig. 3, is an incandescent machine which runs at 220 volts. No lights, however, are run from the circuit. Its purpose is to provide current for the motor, shown in Fig. 1, which operates a 70 inch Sturtevant exhaust fan. The cut so clearly explains the purpose that few words are needed. The motor is of the Thomson-Houston make and is series wound. It runs at a speed of 1,500 revolutions per minute. A belt is carried to a pulley on an overhead shaft, not shown in the engraving. From another pulley on the same shaft a belt is carried to the pulley on the fan. This apparatus, as has been indicated is used to ventilate the tunnel. By means of the box shown at the left connection is made to six galvanized iron pipes that are carried to different places in the tunnel and open into registers placed close to the bottom of the sides of the tunnel. When the fan is in operation the foul air in the tunnel is exhausted through registers, pipes and fan out above the roof of the building containing the apparatus, and fresh air is drawn in through the two mouths of the tunnel. It has not been found necessary as yet to keep the motor in operation except on damp, muggy, close days. The motor too is giving excellent satisfaction. The building containing it is located over the tunnel on LaSalle street close to the north bank of the river and consequently is out of the way and at the same time in the most useful place.

The engine that drives the plant described is a Bullock automatic cut-off, cylinder 13″x18″, speed 205 revolutions per minute. As will be seen by Fig. 3, it has a double fly wheel, keeping both machines in operation while it is running.

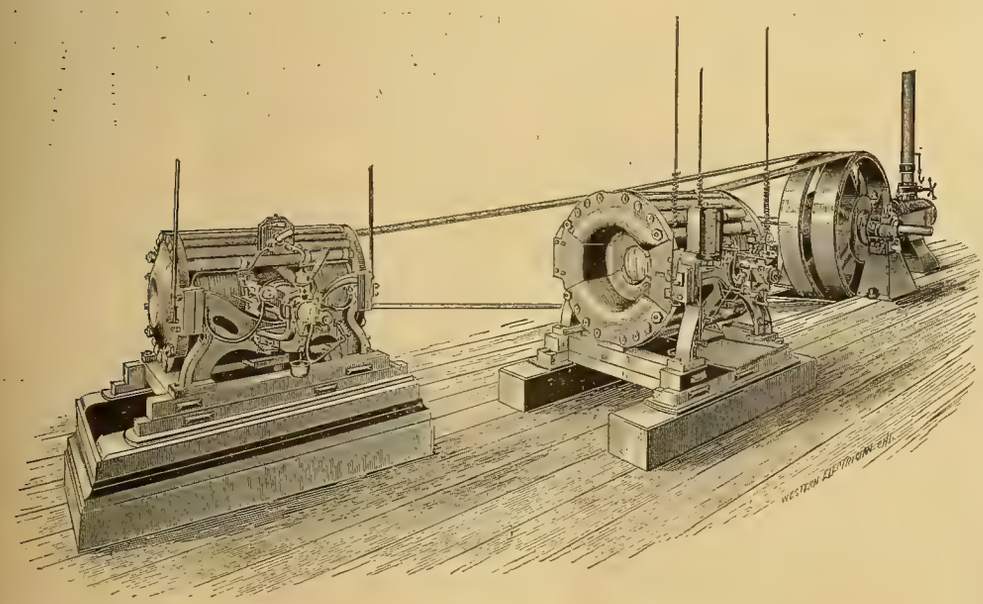


Fig. 3.—Thomson-Houston Plant in the Cable Station.

Edison's First Phonograph.

A correspondent of a Boston paper gives an account of the first Edison phonograph as related to him by the inventor.

"Busily engaged on innumerable things, Mr. Edison carried in his mind for a long time the idea of the phonograph, turning it over and over and from time to time jotting down sketches and memoranda concerning its construction. At length he said to an old German machinist who made models for him that he wanted a machine constructed in a certain manner, but of the use of it he gave no hint. Now and then as the work went on, without seeing the model, Mr. Edison ordered certain changes, which, of course, were duly made. Finally the German was told to bring the machine for examination: Mr. Edison fitted into it the sheet of tinfoil, and turning the crank spoke into the funnel the somewhat familiar verse about Mary and her little lamb. The German regarded him as if he thought he had gone mad; but when Mr. Edison reversed the motion and the phonograph pipingly repeated his stanza, the old man threw up his hands and exclaimed in the utmost astonishment, 'Mein Gott, it talks.'"

Practical Telephony.

BY THOS. D. LOCKWOOD.

PART VIII.

Attention has already been directed to the induction coil which is associated with the Blake and other battery transmitters. The one used in connection with the Blake transmitter is quite small in size. It is composed of two quite separate and distinct helices or circuits; one — the inner, is called the primary circuit. This is made of rather coarse, silk-covered wire, and is wound in two or three layers upon the wooden spool, and its ends are brought out and connected, as shown in Fig. 14, in direct circuits with the contacts and battery. Thus the current of the battery flows, when the circuit is closed by the upward movement of the gravity switch through the primary coil. A hole extends from end to end of the spool, and through it are thrust pieces of soft and oxidized iron wire. These wires are therefore surrounded by the primary helix and when the current passes around the coils of the helix, they become magnetized, and we have virtually an electro-magnet. The other helix is called the secondary helix or coil. It is made of fine, very fine, silk-covered wire, and a great many convolutions of it. This is wound over the primary wire, and quite surrounds it, the ends being led out to the two right-hand binding screws, and thence connected with the receiving telephone, and through the magneto bell with the line and ground wires.

Now, for a few words upon the operation and functions of the induction coil. Of course, it is not added to the apparatus for fun, or simply to make the instrument more complicated. It is quite natural to suppose that since all transmitters are provided with the coil that it is therefore absolutely essential under all circumstances to the successful operation of the instrument. This is not true. Upon very short circuits the transmitter is capable of performing quite efficient service when its electrodes are included directly in the main circuit with the distant receiving telephone. In such a case, it would be necessary, of course, to include the battery, also, in the main circuit; and advisable to wind the receiving telephone with a coarse wire, as otherwise the resistance of the receiver coil will bear too high a ratio to the remainder of the circuit. Why then isn't it so used? Simply because the Blake transmitter has to be used upon lines of a length varying from fifty yards to fifty miles, and while upon a line of the former length, it answers very well, upon a line of the latter, it would not produce sufficient variation in the resistance of the circuit. And it seems necessary to repeat here what I have, I think, already stated, that it is not the strength of the telephone current which enables it successfully to reproduce speech, but the extent of its variation.

The description I have given of the induction coil will be seen in some respects to describe also an electro-magnet. Certainly, it is an electro-magnet with an extra fine wire coil wrapped round. The battery current traverses the primary helix and the contact points, and, of course, since it follows the convolutions of the primary helix, it flows also round the iron core, making the same magnetic. If now the battery circuit is merely closed, and the transmitter is not being operated, nothing more happens. But the moment we say a word to the transmitter, a new series of operations commences. The vary-

ing degree of force with which the carbon and platinum electrodes press upon one another when conversation is being carried on causes a variation of resistance at that point. But if we vary the resistance at any point of an electric circuit, we necessarily by so doing vary the resistance of the entire circuit; and if we vary the resistance of the entire circuit, we can not fail also to vary strength of the current which flows therein. I should also say that the variation which goes on during conversation, is continuous during the conversation. It is supposed that the changes occurring in the air during and caused by conversation, are in the neighborhood of 28,000 per second; and the changes in the character of the vibrations of the diaphragm, and the variations of resistance and of current strength, must closely follow the changes produced by the sound waves of the voice, because in so far as they do not, the reproduced speech is imperfect.

We have reached the point where we find the battery current flowing in the primary coil, varying in obedience to the uttered speech, but it has been said that the primary coil has no conductive connection with the line or secondary circuit. The secondary helix, though close to the primary, is electrically insulated from it by at least two thicknesses of silk. How, then, can any electric changes passing in the latter reach the former? That is what we want to find out now. The answer is *induction*. Of course, I am well aware that induction has, by a slipshod mode of expression become a synonym for all the ills that a telephone is heir to; it is, therefore, not out of order to point out here that it is a pretty useful kind of a phenomenon in its place after all. There isn't any electrical action taking place between the inner and outer helix of the induction coil, as long as the current in the former is constant or unchanging, but just as soon as the current undergoes any kind of a change electrical currents are set up in the secondary. If the diaphragm presses the platinum point and the carbon button closer together, the current in the primary helix increases for a moment in strength, and the result is the development of a current in the secondary helix in a direction opposite to that of the battery current; and if the degree of pressure is then diminished a second current follows in the secondary helix in the same direction as that of the battery current. These currents, it must be clearly understood, do not pass from one helix to the other; but are actually generated or produced in one by the changing of quite independent currents in the other; and the changes occurring in the primary or battery circuit are closely copied by the currents set up by virtue of those changes in the secondary circuit, and which there generated pass away over the line to operate the distant receiver. This, in short, is one of the many ways of generating electricity, and is in accordance with the facts discovered by Faraday more than fifty years ago, that when two electric circuits are close to and parallel with one another, if a current is alternately started and stopped, or increased and decreased, or reversed in one; or if the distance between the two is alternately increased and decreased, induced currents are generated in the other as long as the change in the first continues. But this is not all. The iron core has something to do. I have already said that it is magnetized by the electric current which by means of the turns of the primary wire flows around it. In addition to the discovery of the induction described Faraday also discovered that if a magnet be moved near to a closed wire circuit electrical currents are set up in the latter. We may remember that this discovery is utilized in the magneto and dynamo machine, and in the magneto telephone when used as a transmitter. But suppose that instead of actually moving the magnet near the coil of wire, or conversely, moving the coil near the magnet, we alter the strength of the magnet, making it one instant stronger and the next weaker, and so on, meantime keeping the magnet itself motionless; what then occurs? Why, we find that the currents are generated just as before; for the fact is, that it is not the moving of the *magnet* as a substance that does the work, but the moving of the *magnetism:* the magnetic field changes with respect to the circuit. By placing an iron core within the primary coil we are enabled to avail ourselves of this fact in telephony. Suppose the iron core to have acquired by the presence of the battery current flowing around it a degree of magnetism which we may call 10. When we speak to the transmitter the contacts may at first press closer together, and the current increases in strength; when this happens the magnetism of the iron core naturally is for the moment increased; the next vibration of the diaphragm may greatly decrease the mutual pressure of the contacts, the strength of current flowing in the primary being correspondingly decreased, and the magnetic strength of the core immediately responds and is diminished.

But we have seen that no magnetic change can occur in the immediate proximity of a closed circuit, without producing like electrical changes in the said circuit (and it doesn't matter how the magnetic changes are effected), and as we have also seen that the changes made in the primary circuit, by varying the resistance of the contacts, act first, to set up like currents in the secondary or line circuits; and secondly, to vary the magnetic strength of the core, we have now only a step farther to go, to see that these magnetic changes in the core must also have *their* effect on the secondary coil, and develop there, magneto electric currents also. Such is the case; and therefore the total current generated in the secondary helix and flowing in the line circuit is the sum of the two induced currents—the current induced by the electric changes in the primary coil direct, plus the induced current generated by the magnetic variation. For this reason, and also because the secondary has a great many more convolutions than the primary, the electromotive force urging the current is much greater than that of the battery which produced the ini-

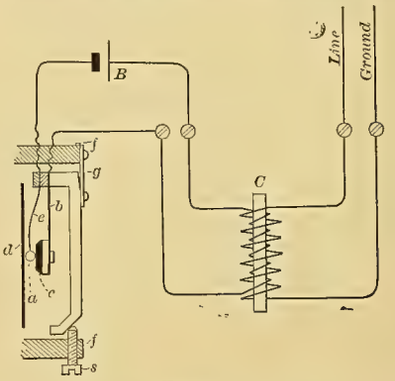


FIG. 14.

tiatory current; for other considerations being considered the e. m. f. depends upon the number of turns of the secondary coil.

This consideration brings me back to the very important question: The operation of the induction coil being explained, what is its function? Why is it required? There are two pretty good reasons. In the first place by its use the *potential* of the source of the current at the transmitter is raised so that it is much more *potent* in overcoming resistance. I have used the word potent deliberately, as it is the key to the former word potential, which although glibly and frequently used now-a-days, is not understood by everyone. Potential, without regard to the sense in which it is used, simply means the power and readiness to do work. Electric potential, accordingly, means the power and readiness of electricity to do work, by setting up a current; and when we speak of a high electric potential, we mean, or should mean, that the source of electricity in the present case, is of such a character as to evolve electricity of a high force, so as to be able to readily overcome a considerable resistance, and consequently traverse a considerable distance, or length of line. The strength of the current depends in fact with a given resistance, upon the difference of potential between the point where the current originates, and the point to which it goes. If no induction coil were used, the potential or electromotive force would only be equal to that of the original battery, usually one cell of Leclanché. But there are a great many more convolutions in the secondary coil than there are in the primary coil through which the battery current flows, and each convolution has its own separate current induced; the potential of the whole is therefore the sum of the separate potentials of the several convolutions and the total is considerable. That the electromotive force of the telephone current is high can readily be demonstrated in an unscientific but convincing manner, by connecting a number of persons in circuit with one another and with a telephone receiver and transmitter. It will be found that conversation can readily be carried on.

The second reason for using the induction coil is as follows: The transmitter works by varying the resistance of a circuit. The variation, however, can never be very great, although it be great for a short circuit. Suppose for example, the normal resistance of the contact between the carbon button and platinum point to be $\frac{1}{4}$ of an ohm. Suppose that to be decreasable to $\frac{1}{16}$ of an ohm, and increasable to 2 ohms, which amounts to a variation of $\frac{31}{16}$ of an ohm. The total normal resistance of the circuit comprising the contacts, battery, primary helix and wires may be called 3 ohms; thus we can effect in a circuit having a normal resistance of 3 ohms a variation of nearly 2 ohms, or from 3 to 5. This variation is considerable, and as the loudness of the reproduced speech depends among other things upon the extent of variation, it will be seen that this promises well. But when we add the resistance of even a short telephone line (say 200 ohms), to our transmitter, the contacts being in the main circuit, the figures now even retaining the primary coil stand as 203 ohms; but we have no means of increasing the variation of resistance with the same contacts and it follows that our circuits as a whole can only vary from 203 to about 205, a variation of two ohms; now although two ohms is a substantial addition to a circuit of 3 ohms, it hardly amounts to any change at all in a circuit of 200 ohms. Hence our need of the induction coil. By its use, we are enabled to reproduce in a long circuit the the range of variation, which the transmitter can effect in a short circuit, so that it is really an electrical lever.—(*To be continued.*)

A Device for Testing Arc Light Circuits to Discover Leaks to Earth. [1]

By C. H. Rudd.

I come to-night to lay before you a plan for testing arc light circuits when in action, to see if they are free of ground. I will first indicate the nature of my subject by diagram, and then follow with such unfolding of principle as I am able to make.

A and A^1 are binding posts connected one to either side of the dynamo *L*. *B* is a grounded post for trial tests, *C* cord and plug. *D* and D^1 are binding posts connected together by a piece of number 36 German silver wire. *E* is a spool of number 36 German silver wire. *F* is a hand telephone. *G* is a two-way switch. *H* is a battery for use when the dynamo is not running. *K* is a small condenser.

When the two-way switch lever stands to the left, the circuit may be traced from the plug and cord *C*, through the German silver wire between posts *D* and D^1, through the hand telephone, switch and condenser to ground. The dynamo is supposed to be running and the engineer wishing to test, puts the telephone to his ear and touches the plug to first one and then the other of posts *A* and A^1. If the circuit is free from escape, there will be no sound in the telephone. If there is escape, there will be more or less buzzing sound according to the electrical distance at which the escape is from the testing point. With the two-way switch lever to the right, the battery is substituted for the condenser and the apparatus is ready to test when the dynamo is not running. In the latter case an escape is indicated by a sharp click in the telephone. The fine wire is put in circuit so that it may burn off in case the condenser breaks down. This apparatus packed in a box serves for testing from lamp to lamp when the dynamo is running. The battery need not be included in a portable outfit.

Having listened to the description of the manner in which the testing device works, you wait for the presentation of the principles involved. The task laid upon me is not without its pleasures. I have enjoyed the study which has been necessary to a proper understanding of the system and hope that the points which have interested me, will impress you in a similar manner.

1 Read before the Chicago Electric Club, April 16th.

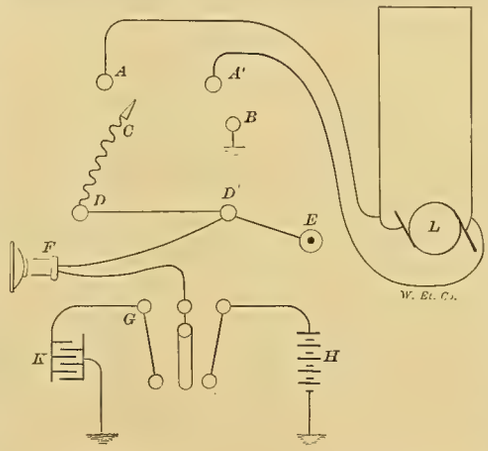
Potential is my first topic, and as I name it, you think of efforts put forth, in your earlier days, to clear the subject of its mysteries. In his third edition of "Electricity and Magnetism" page 30, paragraph 4, Jenkin says: "In considering the potential at a point, it is not necessary to conceive of the presence of any electricity at that point." If we accept and would understand this statement, we must rid our minds of the idea that potential and electromotive force are interchangeable terms. They are not interchangeable terms but express two conditions in nature. These two conditions are intimately related. They are associated in all forms of electrical phenomena just as the strength of the boiler is associated with the power of the steam in producing action in the steam engine, or as the rock and water that go to make a water-fall are associated together in driving the water wheel.

Perhaps I can strike more directly at the point, if I use an electric condenser to aid me. I will ask you to make a mental picture of such a condenser and consider its action. You see the two plates with the insulator between. The value of the insulating material as an insulator determines the time during which the condenser will hold a charge. Therefore the insulation of a condenser is associated with the charge in producing the phenomena connected with the charged condenser. If either plate of a condenser be assumed to be at zero potential, the other will be higher by an amount in direct proportion to the degree of insulation between the plates. I feel justified in saying that potential is a condition under which electricity is confined or held at a density above the normal and this condition exists without the presence of any electricity. Electricity under pressure reveals potential but does not create it. If one pole of a battery should be described as being at zero potential, the other pole might be said to have a potential of infinite height because there is no flow of current backward through the battery. The remarks which I have made about a battery may be applied to the armature of a dynamo when in action. When I speak of two points as having an infinite difference in potential, as in the case of the battery, I simply mean that an infinite electromotive force in the battery would be resisted and kept from producing a backward movement of current through the battery. If a point in an electric light circuit outside of the armature be called zero potential, every other point outside of the armature will be above it by an amount in direct proportion to the resistance between the points. If two of these points be connected by a conductor outside of the circuit, the outside conductor will carry a current the amount of which will be determined by the relation which its resistance bears to the resistance between the points so connected, according to the laws governing the action of derived currents. I have stated what seem to me to be facts and will try to make the use of the facts plain, further on.

Another topic of which I wish to speak is the part which the earth plays in electrical matters. I will introduce the subject by asking the question, "Is the earth a conductor or a reservoir?"

This question was once discussed with a good degree of earnestness. We are apt to be a little superstitious as we think of the globe upon which we live. For instance, we speak of the attraction of the earth and forget that that attraction is not a property exclusively of the earth but a property of all matter so far as is known. Let us assume for a moment that the earth, is a reservoir for electricity and we desire to consider what takes place when we use it for a "return." We must use conductors with a good large surface to get contact with the ground and the ground itself must be possessed of conductivity at least, in the immediate neighborhood of the contact. Who will say where the conductor action ceases and the reservoir action commences? Have we not been ascribing to the earth electrical properties which do not belong to it in any mysterious sense and are we not forced to admit that it is simply a great conductor? You may ask, "Does the same electricity which enters the ground at one end of a telegraph line, emerge at the other and join its mate?" In reply to this question, it is but fair to say that whatever action takes place in a metallic circuit, in the sense in which we speak, takes place also in a circuit of which the ground forms a part. Does electricity seek the earth? I reply, no. Electricity seeks an equilibrium and moves in whatever direction it can to attain this end. If a plate at high potential be charged with electricity and then be connected to another plate of like potential but without charge, the charge upon the first plate will spread itself upon both and the sum of the two quantities will be equal to the quantity originally upon the first plate. The idea that electricity seeks the earth has led some to suppose that the current in electric light circuits is constantly trying to escape. This is a mistake, and because it is a mistake the testing apparatus which we consider to-night, finds useful employment. When a light circuit is grounded at one point, then a current moving in the circuit tries to escape at all points but the one that is grounded. If an observer should take a portable set of testing apparatus and move along the circuit from lamp to lamp, testing for the disposition to escape, he would find that the disposition would grow less and less until he reached the grounded point when it would cease. The reason why the current in a well insulated light circuit is so entirely satisfied to stay at home is this: The dynamo in the circuit creates two conditions, equal in amount and opposite in character. These conditions meet and neutralize each other and as they have plenty of room in which to do their work there is no occasion for them to reach out.

When the conditions tending to electrical action are fully met within a circuit, it might be said that there is no relation existing between the circuit and the earth, but let one point in the circuit be grounded, then a relation springs up at once.



Device For Testing Arc Light Circuits.

The grounded point is at the potential of the earth, and every other point is at a higher potential, the height being in direct proportion to the electrical distance from the grounded point. I might speak of this in another way, viz.: the earth being a conductor, if it is connected to a light circuit at any point, it then brings into action whatever connection it may have with other points, and carries current according to the relation which its resistance bears to the resistance between the points connected, after the manner of derived circuits generally.

I will now refer to the action of the condenser in the testing system. The service rendered by the condenser is that of a cut-off. It takes current enough to indicate the condition of the circuit and no more. The amount of current that will pass through one microfarad, even under high pressure, is small. This point will be understood by referring to the manner in which any condenser acts. If a circuit carrying a current of one ampere should be opened, and a condenser of one microfarad be put into the break, the circuit would appear to be closed for the one millionth part of a second if the charge could enter the condenser at a uniform rate of speed; but the charge enters at a rapidly diminishing rate of speed, on account of the rapid rise of electromotive force in the condenser; hence, the work done in the circuit described must be very small. It would require a condenser of enormous capacity, put into the circuit spoken of, to raise the current fully up to one ampere for an appreciable length of time. If the electromotive force were one volt, the resistance one ohm and the condenser capacity one billion microfarads, the current would lose about one-tenth of one per cent. in the first second.

The telephone receiver plays an important part in the testing apparatus, on account of its extreme sensitiveness. Illustrations of this point are many. I will mention one which I witnessed. I stretched a wire two hundred feet long upon wooden stakes one hundred and twenty-five feet from a telegraph line. One end of the short wire was open, the other end being connected to a hand telephone and thence to ground. A vibratory signal made upon the telegraph wire at a point forty miles distant was distinctly read upon the telephone. The small amount of energy reaching the telephone in this case reminds me of a prescription said to have been made by a homeopathic physician. The prescription runs thus:

Take a little aconite
(Less would be better);
Put it, with care, into Lake Superior.
Stir the mixture well,
Lest it prove inferior.
Dose: Half a drop in water.

Mr. Kreidler: Mr. Chairman, before beginning the discussion this evening on the paper just read, I move a hearty vote of thanks be tendered Mr. Rudd for his able and interesting paper.

The motion was seconded and carried.

Mr. Pearson: Inasmuch as we don't know a great deal about this device that Mr. Rudd has described to us, I would like to have him explain what that binding post is intended for.

Mr. Rudd: [Indicating on diagram.] This grounded binding post B, is merely for the purpose of giving the engineer an idea what the ground sounds like when the dynamo is not running. He has on the telephone a cord and plug, and if he wants to know what kind of a sound the ground would give him he throws the switch to the right, puts the telephone to his ear, and touches the plug to the grounded binding post. He is then prepared to test upon these posts connected with the circuit.

Mr. Warner: What means are used to enable the engineer to distinguish the difference between a dead ground and one at a distance from the station?

Mr. Rudd: That would be a matter of experience, with the engineer I think.

Mr. Warner: I would say that in discussing this testing apparatus, the question has been raised whether it would not endanger the insulation. I would like Mr. Rudd to give his views on that subject.

Mr. Rudd: That point would naturally arise, and I will say that I have made some tests in which I used only a german silver wire, between those posts running direct into the ground; by putting in a condenser, I so reduced the current that the insulation did not have the time to suffer. I have argued in that way from the fact that I have cut the current down to such a point that it will not burn that fine wire, and still it gave me what I needed to do the work. The sensitiveness of the telephone is what I rely upon, as it indicates so very small a current.

Mr. Shain: I would like to ask if Mr. Rudd has patented the device here, or whether it is open for general use?

Mr. Rudd: It is put in the way to be patented. [Laughter.]

Mr. Andrews: I should like to ask if your device will indicate clearly the difference between a dead ground and a very high resistence so as to show a clear comparison between the two?

Mr. Rudd: The ground is only intended for the use of the battery when the dynamo is not running; but your question is a proper one in regard to running the dynamo also, for the telephone if necessary may be so reduced in sensitiveness by means of a shunt, and I have found it necessary to do that in one instance, so that it would not indicate the ground that was not dangerous; that is a mere matter of adjustment. You get the telephone down so it will not record the grounds that are not dangerous.

A Secret Message Answered.

The following incident is told by the Grand Rapids *Telegram-Herald*: G. L. Woolley, the electrician of this city was dining at the Superior house in Cleveland, and it so happened that the only other occupants of the table with him were a bevy of lady telegraph operators. Mr. Woolley has been very successful in his business, and is able to gratify a strong penchant that he has for diamonds, and he generally wears one or two of startling proportions. He is also an expert telegraph operator. As soon as they were seated one of the young ladies began to size him up; then placing her knife blade between the tines of her fork she imitated a telegraph sounder and telegraphed to her companions:

"Get onto his nobs with the big diamond."

Woolley caught on at once, and as soon as all the girls had turned their attention to him he, in the same manner, telegraphed:

"Ah, there! Are you all on?"

A general stampede of ladies followed and they dined somewhere else that day.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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ENGLISH newspapers speak of a scheme for an insurance company which shall write policies only on buildings, or their contents, where the electric light is exclusively used. Rates below the current terms for insurance will be the inducement offered to change from gas to electricity.

MR. RUDD's device for testing arc light circuits for leaks to earth, has the merit of not only being scientific but exceedingly simple. We believe the use of the telephone in this connection is new. To all electric light men, at any rate, this adaptation of the telephone to this purpose, will be highly interesting.

THERE is an increasing interest in Chicago in the electric motor for street car propulsion. Chicago requires rapid transit. The cable roads do not meet all requirements by any means. The very fact that one of a dozen different circumstances may demoralize the service at the busiest time of the day and compel those who depend upon the line to walk is a formidable objection to the system. That the last cable road has thus far proved unsuccessful is an easy inference judging from the criticism with which the officers of the road are scored each morning in the daily press. The officers of the several new transit companies are investigating the electric motor, and perhaps it may solve the vexatious problems which have troubled those who desire to furnish street car facilities.

IN HIS paper recently read before one of the London Electrical societies Mr. Symons gave an excellent expose of the idea that thunderbolts fall from the clouds. He mentioned the fact that clinkers from fire engines often had done duty as thunderbolts and had been sold for two or three dollars. He said that the exploration of a hole dug by the lightning discharge in the ground would often prove interesting. Not infrequently metallic bodies underground determined the path of the lightning. In one case an antique cannon ball was discovered. Those who are in search of hidden treasures, especially those who are on the lookout for Capt. Kidd's buried gold, would do well to investigate with great thoroughness every disturbance in the soil caused by atmospheric electricity.

INCIDENTALLY, two electricians, Mr. Lockwood and Mr. Rudd, define "potential" in articles presented in this issue.

The former writes, "I have used the word 'potent' deliberately as it is the key to the former word 'potential,' which, though glibly and frequently used nowadays, is not understood by every one. Potential, without regard to the sense in which it is used, simply means the power and readiness to do work. Electric potential accordingly means the power and readiness of electricity to do work by setting up a current."

Mr. Rudd says, "I feel justified in saying that potential is a condition under which electricity is confined or held at a density above the normal and this condition exists without the presence of any electricity." Mr. Rudd makes the point that potential and electromotive force are not interchangeable terms.

THE paper read by Thomas Wood before the Ohio Gaslight association will be found in substance in another column. It is of interest both to those engaged in furnishing electric light as well as gas to the public. He predicts that in the near future the incandescent light, which he considers an ideal illuminant for domestic purposes, will become so popular in houses that gas will be completely outrivalled. For street lighting he shows that gas cannot compete with the arc light. Mr. Wood by no means considers that the occupation of the gas men will be gone. The progressive company, he says, realizing the situation, will enter the electrical field. It will not see its business ruined by competition but will supply what the public may demand. He thinks, too, that gas companies are in a better position to enter this field than newly formed companies. He predicts an enormous consumption of fuel gas, as methods of producing it at a much lower cost will be invented. It is an interesting picture which he draws of the ideal company of the future. The question which Mr. Wood treats in his paper is one which is forcing itself on the attention of gas companies.

THE subject of patent legislation came before the Chicago Electric club at its meeting last Monday evening and the proposed bills presented to congress by the National Electric Light association, through Arthur Steuart, general counsel and chairman of the legal committee, printed in the last issue of this paper, received by unanimous vote the indorsement of the club.

At the meeting of the club January 16th, the proceedings of which were reported in No. 3, Vol. II, of the WESTERN ELECTRICIAN, C. A. Brown presented an array of cogent reasons why the original plan of the Legal committee of the Electric Light association, i. e., the appointment of a commission to consider a wholesale revision of the patent law and practice should not be followed. No formal action was taken by the club but the impression upon the members was that Mr. Brown's points were well taken.

The bills now pending, as stated last week, are aimed at specific changes. They have in view a few simple changes which, if adopted, will greatly improve the law and the practice. The bills should receive the indorsement not only of electricians but of all others directly or indirectly interested in patents.

PROFESSOR SYLVANUS P. THOMPSON enters the discussion of the alternating vs. the direct current system, elicited by the papers of Messrs. Kapp and Mackenzie before the Society of Telegraph Engineers and Electricians in London, as will be seen by an abstract published this week. Mr. Compton's remarks he challenged first in that the basis of Mr. Crompton's position was that the distribution must not exceed 500 volts—a forced position from the fact that his dynamo would not do it. The professor also took Mr. Crompton to task for the assumption that alternate current dynamos were necessarily bad as compared with continuous current dynamos, because they required more room, were wasteful and would not work in parallel. Mr. Crompton, he argued, was not up with the accomplishments of the day in the line of alternate current dynamos, for the professor knew of such dynamos that were as far in advance of the older forms as the continuous current dynamos of the present are in advance of those of five years ago. The professor showed how alternate machines could be worked in parallel.

In regard to the storage system he said that while he thought the storage system in the abstract the better method, he did not want at this stage of things to see unnecessary difficulties put in the way of the fullest and most complete trial being given to the system of distribution by means of transformers.

Thus the discussion progresses and new ideas on this most interesting subject are brought to light. The expected contribution to the literature of the day on the subject from Professor F. B. Badt, before the Chicago Electric club, has been deferred until the next issue. The professor will argue for the alternating side of the question and will make a strong plea.

THE London *Electrician* hits straight from the shoulder, so to speak, in this note on the United States Supreme court's decision in the Bell case.

"Although three judges dissented from the finding of the court in the case of the American Bell Telephone company, commented on in our leading article this week, it should be noticed that the dissent relates only to that part of the case with which Drawbaugh's alleged invention was concerned. On all the other points the court seems to have been unanimous, and even on this the dissentient judges cast no doubt upon the independence of Bell's discovery, but are unable to dismiss the whole of Drawbaugh's witnesses as untrustworthy. The language employed by Justice Bradley, however, in favor of Drawbaugh's claims is itself decisively against their legal validity. The following passage will sufficiently illustrate our meaning: 'He [Bell] was a man whose professional experience and whose scientific attainments enabled him to see at a glance the importance of it [the telephone]. Drawbaugh was a different sort of man. He did not see it. Had he done so he would have taken measures to interest persons with him in it and have brought it out.' According to our patent law the man who sees, and acts on what he sees, is alone entitled to a patent; and Drawbaugh in an English court could only have established his own claims by destroying his title to a patent, publicity and usage being fatal to exclusive rights. But without reference to English patent law it is evident that except for Bell's successful discovery the world would never have heard anything of Drawbaugh's magneto telephone, supposing he ever invented one—which is supposing a great deal. It follows that we owe both the discovery and its application to Bell; to Drawbaugh we owe absolutely nothing. To transfer the ownership in the invention from Bell to Drawbaugh would therefore have been grossly unfair in any case; but to do so on the testimony of a parcel of ignorant villagers would have been absurd."

OF great interest to manufacturing electric light companies is the appended editorial note from the London *Electrical Review:*

"Copper has been a great deal before the public latterly, and it may be of interest to give a few statistics of the world's production of the commodity. Messrs. Merton & Co. have just issued their annual compilation on the subject, from which it is to be gathered that from two sources the supply has largely increased. The United States mines produced 79,109 tons of fine copper in 1887, compared with 69,805 tons in 1886, 74,050 tons in 1885, 64,700 tons in 1883, and 51,570 tons in 1882. The production last year was nearly three and a half times larger than the production in 1879. In Spain and Portugal the output of 54,056 tons last year compares with 49,653 tons in the preceding year, 47,873 tons in 1885, 46,415 tons in 1884, 44,607 tons in 1883, and 39,560 tons in 1882. The Chilian production has, however, been falling off steadily since 1882. In that year the amount produced was 42,909 tons, in 1883 it was 41,099 tons, in 1884 41,648 tons, in 1885 38,500 tons, in 1886 35,025 tons, and last year 29,150 tons. Adding the figures of these three principal sources of supply together, it will be seen that the aggregate last year was 162,314 tons, against 153,463 tons in the preceding year, or an increase of 8,851 tons in the past year. The increase since the close of 1887 has, of course, been on a very much larger scale, and if production is continued at the present rate for the rest of the year the figures at the close will not be far short of 200,000, if, indeed, it does not exceed that figure. The value of the copper imported into England from the states in the last two months was £282,022 against £7,350 only in the corresponding months of last year. There seems every prospect of the tactics of the ring receiving a severe check shortly. The output of copper is increasing largely in various quarters over which the French financiers have little control, and a downward run in prices may be antciipated."

The Buckling of Accumulator Plates.

By Philip Atkinson, Ph. D.

It may not be generally understood that in the over-discharging of a storage battery lies the principal danger of injury from the buckling of the plates, a danger much greater than any which may result from overcharging, although this also requires to be guarded against. Both the charging and discharging are chemical reactions, of which the one is the reverse of the other.

The materials present in a cell are the plates—usually seven positives interleaved with eight negatives, with spaces between—and dilute sulphuric acid. These plates are grids of metallic lead, ¼ to $\frac{3}{16}$ of an inch thick, with openings about ⅜ of an inch square, covering the entire surface, which are filled with a paste composed of the red oxides of lead and sulphuric acid; minium, $Pb_3 O_4$, being used in the paste for the positive plates, and litharge Pb O, in that for the negatives.

The products of the chemical reactions are lead peroxide, $Pb O_2$, lead sulphate, $Pb S O_4$, and spongy metallic lead. During the charging an electric current from a dynamo or primary battery being passed through the cell from the positive to the negative plates, the paste in the positives is reduced chiefly to lead peroxide, while that in the negatives is reduced chiefly to lead sulphate; and sulphuric acid, being set free, accumulates in the solution considerably in excess of the original proportion, which is about 10 per cent. During the discharging, which takes place spontaneously, when the external circuit between the two sets of plates is completed, the direction of the electric current is reversed, passing through the internal circuit from the negative to the positive plates, and through the external from the positive to the negative; and the chemical reaction is also reversed; sulphuric acid, taken up from the solution, replaces the oxygen in the lead peroxide of the positive plates changing it chiefly to lead sulphate, and the lead sulphate of the negatives chiefly to spongy lead. From this it will be seen that during the discharge sulphuric acid, a *liquid*, is changed to lead sulphate, a *hard solid*.

If the discharge is continued only while the e. m. f. remains practically constant, or at about two volts, no injury is done to the positive plates from this accumulation of solid matter, but if continued much beyond a point when the e. m. f. begins to fall off rapidly, the excess of this accumulation exceeds the strength of the plates, and warping, or buckling, as it is termed, is the result. If the accumulation were uniform on every part of both surfaces such a result could not occur, and no serious harm would follow from over-discharge; but it is far from being uniform. The acid tends to gravitate toward the bottom of the solution, where, in consequence both of the greater supply of acid and the resulting increase of fluid conductivity, the formation of the sulphate progresses more rapidly than in the upper part. Still this would not cause buckling if the excess were uniform on both surfaces of the same plate. But the constant flow of the current in one direction during the discharge; the difference in conductivity in the surface formations on opposite sides, and in the fluid in contact, which must result; and probably a certain degree of inductive electric action, tending to make opposite surfaces, and the fluid in contact, positive and negative in a manner analogous to that of the Leyden jar, results in the greater accumulation of sulphate on one side of the plate than on the other, and this excess of rigid matter bends the soft lead grids.

This result is increased by the peculiar form of the paste plugs which fill the grid openings. Each opening being smaller in the center than at either surface, the rectangular plug which fills it takes the same shape, being contracted at the center and expanding towards each surface; a shape given to prevent its dropping out or being easily forced out of place. Each, then, is a sort of double wedge, sloping on four sides from each plate surface to the center; and the enlargement which results from the conversion of lead peroxide into sulphate during discharge being greater from center to surface in one half of this wedge than in the opposite half, the ratio of expansion increasing toward the surface with increase of mass, making the wedge broader at the base, or surface, in proportion to its length than before enlargement, it is evident that this expansion in every plug over one entire surface of a plate, being greater than on the opposite surface, must warp the plate whenever it exceeds the limits of strength of material, or of space allowed for the expansion.

An examination of a cell in which the plates have buckled, shows that all the plates bend in the same direction, and that the curving is greatest in the lower part and decreases toward the upper part; facts which are in accordance with the foregoing views. This shows that the negative plates are probably affected, to a limited extent, by some of the causes which warp the positives. The two sets are kept apart by rubber plugs drawn into several of the openings in the negatives, and when the positives buckle, these plugs exert a certain pressure on the negatives to force them in the same direction, and this pressure combines with the other causes to produce the bending. This warping of the negatives has however the advantage of preventing the short-circuiting which would occur if they remained straight and the positives were forced against them, or plugs of paste forced out of the positives against them.

Buckled plates may be bent straight, but it is evident that the buckling and straightening tends to loosen the paste plugs, forcing them out of shape, so that they no longer fit the openings accurately as at first, interstices being thus formed into which the acid solution penetrates, and comes in contact with the interior of the lead grid. This leads to an irregular formation of solid matter during the chemical reactions; loosened plugs also drop out and produce short-circuiting, and the grid itself being weakened by the alternate bendings the whole structure eventually breaks up.

To prevent buckling, the discharge should be stopped whenever the e. m. f. begins to fall much below its normal value. The internal resistance, at this stage, becomes greatly increased by the chemical reaction, which reduces the conductivity of the fluid by the rapid reduction of its proportionate supply of sulphuric acid, leaving it mostly water, and changing this acid into lead sulphate, a solid of very high resistance; and the energy of the battery, expended in overcoming this internal resistance, is taken from that required for useful work; so that to continue to operate a battery under such conditions, is not only ruinous to the plates, but wasteful and expensive, giving small outcome for the time expended.

Protection of Buildings from Lightning.

Professor Oliver J. Lodge, a well-known English electrician, has recently been making some experiments intended to show that lightning rods constructed according to the most approved scientific theory, and in accordance with the recommendations of the English lightning rod commission made in 1881, may still be defective, and not afford the protection claimed for them. Professor Lodge does not call in question the importance of good ground connection, or good air connection, but claims that the conductivity of the conductor, however good, has not the merit usually claimed for it; and that even a good copper conductor well grounded and terminating above in a point of the most approved construction might still be a very defective means of protection. This claim seems to be based chiefly on the ground of electric self-induction set up in the rod by the discharge, which tends to neutralize conductivity and prevent the passage of a current within the short time occupied by the discharge. To illustrate this he uses the induced current of the Töpler or Voss influence machine.

In this well-known machine a charge of static electricity, generated by the inductive action of two glass plates, is stored up in two Leyden jars connected with opposite parts of the machine, the interior coating of one jar becoming highly positive, while that of the opposite jar becomes highly negative; the outside coatings, when connected by a conductor, being similarly charged by induction in reverse order. Sliding electrodes, terminating in balls, are connected with the inside coatings, and separated by a variable distance. When the e. m. f. produced by the difference of potential between the inside coatings becomes sufficient to overcome the resistance of the air, a discharge accompanied with spark and snap takes place from the positive to the negative electrode, and the induction charge on the outside coatings is at the same instant discharged, in reverse order through the conductor connecting them; and if this conductor be severed so as to leave an air space between the terminals, or a switch be interposed and opened, this discharge becomes manifest by a spark occurring simultaneously with the spark of the direct discharge.

Professor Lodge arranges two conductors for this induced current; one severed as above, the terminals ending in balls with an air space between, the other a shunt, continuous, and consisting of a different metal for each different experiment. In one experiment he uses for the shunt a long number 1 copper wire extending round the room, which ought apparently to be sufficient to carry the induced current, and prevent any spark through the short air space between the terminals of the severed conductors; but, instead of this, the length of spark is but slightly diminished, a result which he attributes to the great self-induction of the long copper wire almost entirely preventing the passage of the spark, whose period is of almost infinitesimal duration. A fine iron wire of equal length substituted for the large copper wire produces only a slight difference, shortening the length of spark slightly, whereas, from the greatly increased resistance, the spark should apparently have been longer. From this Professor Lodge infers that iron is better than copper for an electrostatic conductor, the infinitesimal duration of the discharge being insufficient to develop magnetism in the iron, while its greater resistance slightly diminishes the length and violence of the spark. This point he further elucidates by using a capillary tube of some 100,000 ohms resistance for the shunt, with the effect of greatly reducing the energy of the spark. Another experiment consists in the use of a shunt composed of a tinfoil strip folded zigzag with insulation between the layers, which, having very little self-induction, reduces the spark-length much below that with the copper wire shunt. But with a shunt of tinfoil wound spirally round a glass tube, which has much greater self induction the spark-length is considerably increased. The insertion of an iron core into this glass tube, changing it apparently to a powerful induction coil traversed by alternating currents of moderate period, should increase the spark-length, but no such increase occurs; from which he infers that the iron, during the rapid alternations of current, completely loses its magnetic properties. Another experiment appears to prove that the discharge will pass through a moderate air space rather than follow a comparatively short loop of stout copper wire.

From these various experiments Professor Lodge undertakes to account for the well known phenomena of side strokes from lightning conductors, the lightning, without any apparent reason, leaving the conductor and entering the building, apparently following the path of high instead of low resistance to earth; the self induction of the conductor, he maintains, being sufficient, irrespective of its electric resistance, to stop the current during its rapid passage and force it laterally outwards. In illustration of this he uses a U-shaped tube filled with water, in one limb of which a piston moves; a gradual pressure on the piston forces the water out of the other limb, but a sudden pressure given by a blow, bursts the tube, the time being insufficient for the water to flow out; an elastic tube would expand to accommodate the sudden increase of volume; and a somewhat analogous safeguard might be provided in a lightning conductor, by connecting it with metal roofs, or other large masses of metal in a building, which would act as condensers, and give the conductor more time to perform its work. He also recommends a conducting system of numerous small wires rather than a single large conductor.

He also shows by the usual experiment of a charged plate suspended over one connected with the earth on which are placed numerous objects, some terminating in points and others in knobs, that with a discharge resulting from

slow accumulation a point receives it quicker than a knob, even at a greater distance, and a small knob more quickly than a large one; but if the entire charge be suddenly transferred from another body to the upper plate, all are equally liable to be struck. Hence, he infers that with a sudden transfer of charge from an upper to a lower cloud, a lightning conductor of even the best construction affords no protection to a building beneath; and that the common theory is fallacious that the lightning rod protects a space represented by a cone whose apex is at the point, and the radius of whose base equals the height; that absolute protection is not attainable, but that the risk may be reduced to a minimum by employing numerous small iron wires, such as the ordinary galvanized iron telegraph wires, with earth connections below, and terminating above in barbed wire, attached to the eaves and roof; discarding elevated rods, large rods, and copper conductors, giving the preference to iron, not only on account of its superior electric qualities for this purpose, but also as a more sure protection against theft, to which the copper is greatly exposed.

Future Gas Companies.

At the annual meeting of the Ohio Gaslight association at Sandusky, Thomas Wood read a paper on incandescent lights and fuel gas, which was full of interest. In beginning his paper Mr. Wood answered the question: What constitutes an ideal domestic burner for illuminating purposes? He said:

"In the first place, such a burner must not blacken our walls and ceilings, neither must it give off deleterious products of combustion; it must be a steady light and not subject to draughts; it must not give out heat in summer; it must not be possible for inflammable goods to ignite by coming in contact with it; it must be a light that will have no ill effect if by accident the key is left open; it must be a light that our country cousins cannot blow out; neither must it be one that requires dangerous matches to ignite it; and lastly it must be a fairly cheap light. Now, gentlemen, if you have thrown prejudice to the winds, perhaps you can recognize in this ideal burner the incandescent electric light for domestic use. Now, if this light is an ideal burner, who is going to prevent its adoption by the public? Gas companies cannot, and if they cannot, no one can; so in my mind the wisest course to pursue is to admit what we know to be true, and proceed at once to supply the demand, increase our revenue, push out into the suburbs of our cities, sell it as cheaply as possible, and don't let others come in and take away what rightly belongs to you. If there is any money to be made in the business by others there is still more in it for us. For store purposes, where the hours of burning are defined, I think it better to abandon the meter system and fix a price per annum or per month for each lamp, taking into consideration the hours of use as a basis for charges. For private dwellings this would not be practicable, and we would have to resort in this case to meters, or pehaps fix upon a price for furnishing the current and have the consumer purchase the bulbs or lamps whenever renewals were needed; in this way economy would cheapen the light to the consumer. Any method that will dispense with the meter, and still be satisfactory, will be the one to adopt. I cannot understand how some gas companies who have the incandescent electric system as a competitor can console themselves with the fact that it is not injurious to their gas business, even taking it for granted they are still selling as much gas as before its advent. Is this a just reason why they should make no effort to secure their old patronage? I think not, for it is human nature to secure a whole loaf in place of the half when it is possible to get it. A gas company's revenues would certainly be increased by the step, and a dangerous rival would be made profitable."

Mr. Wood said it was a mistake to think that those who were using incandescent lights would in the future resume the use of gas. The incandescent lamp was bound to remain where it was and was sure to find its way into other places, but the question arose what were the gas companies to do with their prior investment. The answer was: "Push that, to cheapen it to its lowest point, and urge its use for power and cook stoves until such time that you find yourselves able to supply gas for heating purposes of all kinds. What difference does it make to a company whether the money expended for improvement account be for coal benches, holders and mains, or dynamos, boilers and wire? The arc light, so far as the writer has ascertained, has asserted pretty generally throughout the country its supremacy on our streets, and this, in spite of all opposition from gas companies, showing conclusively that it has gained its position by the force of demand for the fittest. Incandescent electric light is just as surely finding its position and field of usefulness and in its turn will assert its supremacy; and why? Because it has the qualifications called for in the public specifications."

After saying that duplicate machinery and storage batteries would make the electric light service perfectly reliable, Mr. Wood drew comparisons of progressive companies, and of those corporations which failed to respond to new requirements. The progressive company would have "one set of officers, whose principal qualification shall be progressiveness, their duties to be divided between electric lighting of all kinds, including electric power, fuel gas for all purposes, including gas engines; also incandescent lights off fuel gas mains. No let us see what the plant will consist of? One set of mains for fuel gas, from which our patrons will draw all their fuel, and also light if they wish. Gas engines will be run economically with this gas. One set of meters only will be required. There will be no coal gas benches as we have now, as the method of manufacture is too laborious, too expensive and very primitive, not to say barbarous, everything now being built on the horizontal plan requiring the greatest possible exertion to both draw a charge and stoke. The generators of the future will be on the cupola style, feeding by gravitation from the top. Native coals in all probability will be sufficiently good to make gas of. One portion of the plant will be devoted to the dynamos and engines for furnishing the electric light. Where the coal gas benches now are will be boilers, or perhaps even these will be unnecessary if gas engines be used. If steam boilers be used, they will be fired with producer and gas, the boilers will become simply pressure regulators. The revenues of gas companies will be increased five-fold if not more, the consumer will get cheaper fuel, cheaper power and cheaper light. Native coal fields will become more valuable, and we will not pay tribute to other states as heretofore. The change from illuminating coal gas to fuel gas will perhaps be a slow one, owing to the conservatism of gas companies and imperfected details, but eventually it will be brought about in spite of all obstacles. If a company is operated as pictured it will furnish arc lighting, incandescent electric lighting and electric motors, fuel gas, incandescent gas lighting and gas engines. Gas will be made on a larger scale, with less dirt and nuisance and without that laboriousness now made necessary. Valves, levers and push buttons will displace scoop, drawing hook, and wheelbarrow."

Mr. Wood then described the representative of the companies which refused to adopt progressive ideas. He said; "He will, of course, go on making coal gas in the old way; he will still wrestle with stopped stand-pipes, steam-jet exhausters, naphthaline and worry over how much a bushel of coke weighs. He will try to convince his customers that he knows better than they do what they want and that anything but his gas is of no account; he will also keep on cutting out items from the newspapers whenever he finds it recorded that an electric light some where failed to flicker. He will still maintain that there is not a company in the country making anything out of electric lighting; and it is only a matter of time when some fellow slips into his town and noting things, works up an arc light company, captures the street lighting and some of our friend's best customers. The price of gas is lowered, all kinds of patent gas burners are invented to recapture those lost consumers, a fight ensues, factions are made in the town and the arc light company adds an incandescent plant to that of arc light and captures more of our friend's consumers, and, to cap the climax, another fellow comes along and proposes to supply fuel gas to the citizens, gets a franchise, puts in a pipe service, and our friend wakes up some fine morning to find that what the electric light fellow has left him in the shape of lighting has been captured by the fellow with the fuel gas plant, who puts in the incandescent gas burners."

Speaking of fuel gas Mr. Wood said: "As far as the present meter business is concerned, I think if this transformation of the gas business is brought about that the demand for gas meters would be quadrupled and the use of the larger sizes of meters would be made necessary, but if accuracy could be insured with a much smaller meter with quicker action, I think it would be better adapted for the purpose. Fuel gas, if it can be manufactured at a price by which it could be sold with a profit at a lower or as low price as coal, would prove a larger field than all the kinds of lighting put together, and is certainly worth our while to investigate thoroughly. The owners of the smallest houses of our cities would become our patrons, and a small profit per 1,000′ would represent a wide margin when taking into consideration the large amount that would be consumed. But is the fuel gas practical and has there been sufficient progress made to date to warrant gas companies taking hold of it with any assurance of success? In the first place what assurance do we require? Do we want some one to come along and guarantee us a profit of twenty per cent. on our investment if we enter the field? If so, the patentees of the different processes might just as well negotiate with the shoemaker as with the gas company. I think all the assurance we want in the premises is, that with certain apparatus we can get certain results from a ton of coal (the kind of coal being specified), or that from a ton of coal we can get a certain amount of available deliverable heat units. The balance we should be capable of working out ourselves, such as labor, leakage, cost of gas at consumer's meter, and such other data that we should certainly be more familiar with than any one else. Of course, the fuel gas will have to have an odor, and must be delivered at a proper pressure and proper appliances for governing supply and insuring perfect safety will have to be calculated on; in fact, the gas man must try to improve on methods adopted, and do his best to hasten the day when solid fuel in our homes shall be no more—in other words, have got to take hold of the fuel gas business in its infancy, or it will get weaned away from us."

Shakespeare and Electricity.

The same year which saw the publication of Gilbert's work on electricity witnessed also the appearance of Shakespeare's plays of "Hamlet" and "Much Ado About Nothing." That Shakespeare had considerable knowledge of atmospheric phenomena, now, but of course not then, known to be electrical, is apparent from many instances. Witness Prospero's

> "to the dread rattling thunder
> Have I given fire and rifted Jove's stout oak
> With his own bolt."

Or Ariel's self description in the guise of St. Elmo's fire:

> "Sometimes I'd divide
> And burn in many places: on the topmast,
> The yards, and bowsprit would I flame distinctly,
> Then meet and join.

There are but two passages, so far as I have been able to discover, in which the poet makes reference to the attraction of iron. The first is in "Midsummer Night's Dream" (act ii, scene 2):

> "You draw me, you hard-hearted adamant,
> But yet you draw not iron, for my heart
> Is true as steel. Leave you your power to draw,
> And I shall have no power to follow you."

The second is in "Troilus and Cressida" (act iii, scene 2):

> "—— truth tir'd with iteration
> As true as steel, as plantage to the moon,
> As sun to day, as turtle to her mate,
> As iron to adamant."

Park Benjamin in April Forum.

The Italian Electrical society has offered a prize of 600 francs for the best work on electromagnets, with especial reference to their application to dynamos.

Chicago Electric Club.

A regular meeting of the Chicago Electric club was held Monday evening last, with Vice-President Brown in the chair. The minutes of the last meeting were read and approved.

Mr. Kreidler, for the board of managers, reported that after two meetings, the board had deemed it best for the club to remain in its present quarters and to lease the whole floor, a part of which is now occupied by the club, at $1,500 per year. The restaurateurs had declared their intention of reorganizing the service and making everything satisfactory in that respect. A paper, authorizing the secretary to execute the lease on the terms mentioned, was being circulated among the managers and when all the signatures had been obtained the lease would be executed.

Mr. Shain said that he understood Professor Badt would not be in Chicago at the time for the next meeting of the club and as the members were desirous of hearing the paper he has in preparation, on the value of the alternating current as compared with the continuous current he moved that when the club aadjourned, it adjourn until next Monday evening when the professor could be present. The motion was carried.

Vice-president Brown called the secretary to the chair and offered the appended :

"WHEREAS, The legal committee of the National Electric Light association has drafted bills looking to the establishing of a Court of Patent Appeals, to the increase in the salary of the commissioner of patents and to other amendments in the patent law as set forth in the copies of the bills hereto attached, and,

"WHEREAS, These measures have received the approval of the National Electric Light association and appearing to us to be wise and deserving of support. Now, therefore, be it

"*Resolved*, That the secretary of the Chicago Electric club be and hereby is instructed to convey to Hon. Edward Lane, member from this state to the House of Representatives and a member of the House committee on patents, the sentiment of the club approving these measures, and to urge a favorable action thereon by the committee on patents."

The resolution has reference to the patent legislative bills published in the last issue, pages 187, 188.

Mr. Brown said that doubtless all present had read the bills which had appeared in the electrical papers and had also read the editorial in the WESTERN ELECTRICIAN giving Arthur Steuart's sentiments in regard to the bills, and the speaker supposed that no further remarks on the subject were necessary. He had talked with a great many persons on this subject and all were unanimous in their approval of the bills now proposed. The National Electric Light association had indorsed the proposed bills and he thought the Chicago Electric club should also indorse them. He consequently moved the adoption of the resolution.

Mr. Cutter asked if it was necessary to express an opinion at this meeting. He would prefer to wait and study over the matter.

Mr. Brown said the matter was a live issue and was now before the committees in both the senate and house, and therefore urged that whatever action be taken should be taken immediately, as a delay until the next meeting might render action then taken of no avail.

The speaker stated that he had a letter from Arthur Steuart, counsel to the National Electric Light association and chairman of the Legal committee, which he would read if desired. At the request of Mr. Shain, Mr. Brown read the letter appended:

DEAR SIR: — The Hon. Edward Lane, representative from your state, is a member of the House Committee on Patents. I enclose to you copies of the bills that have been introduced by the Legal committee of the National Electric Light association, into the senate and the house for the purpose of attempting to improve the condition of the patent system. It was the original intention of the committee to ask congress to appoint a commission to revise the law generally, but this plan we were compelled to abandon, in consequence of the great unanimity of opinion that we found existing among the members of the association, that to open the question of general revision would expose the patent system to the attacks of its enemies, and might result in doing it great injury. We have, however, determined to prosecute the bills that I send you n our effort to improve without running the risk of doing injury to the system. You will appreciate the desirability of having a thoroughly equipped man at the head of such an office as the Patent office, and the importance of doing something to secure his permanent retention of the place, for the purpose of systematizing and permanently directing the work of the bureau. The present confused condition of the office, is due to the fact that, during the past twenty years, the commissioners of patents, and the acting commissioners who have held the office, have been men who, as a rule when they took the place, knew little of the duties of the office, and whose terms of office averaged between thirteen and fourteen months each. We hope to rectify these defects by increasing the compensation of the position to $8,000, and fixing the term at six years, instead of leaving it optional with the administration to remove the head of the department, whenever, for political reasons, it seems desirable.

The Patent office pays the government an annual revenue of about $150,000, and we think they should not begrudge $3,500 additional, when added to the salary of the Commissioner of Patents.

We next propose to establish a Court of Patent Appeals to be composed of expert patent lawyers, so that we may feel in going before that court with a case involving technical questions of steam or electrical engineering, that the judges will be fully equal to the task of comprehending the problem presented to them, and of deciding the case in a thoroughly intelligent manner. It is also very desirable that this court should sit to hear appeals from the Commissioner of Patents, as well as from the Circuit courts, so that all questions relative to patents, either in relation to their issuance, or in rela ion to rights, and questions of infringement growing out of them, may be passed upon by the same appellate tribunal, and rules of law announced by a single competent body, for the guidance and government of both these branches of the government service.

The bill which provides for the alteration of Sec. 4,887 removes the limitation which has heretofore existed on United States patents, by foreign patents of prior date, while at the same time retaining the rule that foreign patentees must make application for their patents in this country within two years from the date of their foreign patent. We would be indebted if you would address Mr. Lane upon the question of these bills and urge upon him the desirability of their passage. They have been approved by the association, and will be of great benefit to all holders of patent property. I would be glad to hear from you on this subject at your earliest convenience.

ARTHUR STEUART.

The resolution offered by Mr. Brown was then unanimously adopted.

Mr. Rudd's paper was next presented. The paper and subsequent discussion will be found elsewhere.

The club adjourned to Monday evening, April 23d.

The Alternating vs. The Direct Current System.

In continuation of the discussion on the subject before the London Society of Telegraph Engineers and Electricians, Mr Mordey said, in reply to Mr. Crompton, that in the United States alternate current machines were run in parallel, not only in one large station but across rivers, a station on one side of a river supplying mains connected with a network on the other side as well as on its own side, so that when more power is required the dynamos on the opposite side can be switched in. He objected to the position taken by Mr. Kapp in regard to low tension network with transformers, and thought the great advantage of transformers was, that they got rid of the enormous cost of a low tension network. The cost of copper in such a system is a serious item. As transformers regulated so perfectly, were very efficient for small loads, and as loss in the main conductors could, in effect, be practically eliminated, distribution network was unnecessary, except so far as it might be required of one part to aid another part to carry a full current. He disagreed as to the danger of having a having a separate transformer for every house ; so many might not be necessary, but there ought to be some arrangement for cutting out a transformer when it went wrong ; and in large buildings, like hotels, it might be well to have two or three, with a network of the inexpensive primary conductors. He considered the regulation of the constant current system, with an alternate current dynamo not at all easy; did not know that it had yet been done. With a direct current system a constant current could be regulated and maintained, but with an alternating system the problem had not yet been solved in practice. The regulation of the transformers alone solved only one part of the problem. The preliminary difficulty with the dynamos at the station had not yet been overcome. A second difficulty was in the e. m. f. in a series or any other system : 2,000 to 3,000 volts was the limit ; beyond that the leads must be increased. It was just as well to start with the parallel system, in which there was no problem requiring solution during progress. He liked the calorimeter method of testing transformers, and believed it could be made very accurate even when roughly carried out, as he had proved by experiment. He showed how the alternations of an alternating dynamo could be kept constant at reduced speed, but had not tested his method practically.

Professor Sylvanus P. Thompson thought Mr. Mackenzie's paper open to serious criticism. He could not understand what would be the result of dividing transformers into a Gaulard and a non-Gaulard type. In the Gaulard type the secondary occupied the same position with regard to the iron core as the primary. It would seem that there must be a secondary wire placed between primary, in which case there could be no coefficient of transformation at all. Gaulard's substitution of flat metal washers for wire coils was a novelty, but the transformer so constructed was wholly unsuitable for parallel distribution, and had a maximum risk of break down with a minimum performance. To put the secondary wire in the same position with regard to the core as the primary, was to invite failure of insulation. He thought Mr. Crompton's remarks ought not to go unchallenged. The basis of Mr. Crompton's position was first that distribution must not exceed 500 volts. Mr. Crompton did not take 5,000 or 10,000, for the very good reason that his dynamos would not do it. Some other commutator arrangement than that of the Gramme type must be found in order to work 5,000.

A second assumption underlying Mr. Crompton's whole argument, was that alternate current dynamos were necessarily bad as compared with continuous ones, because they required more room, were very wasteful, and would not work in parallel. He was afraid Mr Crompton was not up to the latest in alternate dynamos. He knew such dynamos that were as much better than the alternate dynamos already known as were the continuous current machines of the present day compared with those of five years ago. It was easy to show how alternate machines could work in parallel. Put into the circuit of the two machines to be synchronized two coils, and let the two act as one another. like Professor Perry's two ; as long as there was a similarity of phase there would be action between the two ; but with difference of phase, action would cease at once. The motion of the two coils might then be caused to work an automatic regulator. He thought storage, in the abstract, the better method, but did not want, at this stage, to see unnecessary difficulties put in the way of the fullest and most complete trial being given to the system of distribution by transformers. He regretted that nothing had been said about that class of continuous current transformers known as motor dynamos, which appeared to him to be a real success. Very little was known about those machines. When working properly, the currents, in the incoming coil on the armature and the outgoing coil neutralized one another's self induction. There was a mutual induction between the two, and as a result here, as in the alternate current transformers, the self-inductions of the two separate coils were practically wiped out by the mutual induction between the two. The consequence was that these machines hardly sparked at all when doing full work. Is was clear that for all purposes of distribution, transformers were the order of the day, whether by alternate current, accumulators, or motor dynamos. This question of transformation must be studied in all its bearings for the basis of immediate distribution.

Mr. Kapp had no confidence in storage batteries, and was therefore in favor of transformers. He would hail the day when a good battery could be obtained ; 60 per cent. was the highest efficiency to be obtained from any such battery, while 90 to 96 per cent. could easily be obtained from tran formers. There were but very few battery stations in the world, one in London, one in Berlin, one in Vienna ; while there were many hundred central stations, operated on other systems, in Europe and America. If he knew batteries were good enough he would never presume to put down an alternating plant. but he had never seen a good battery. But to provide for the day when batteries would be good enough, plants must now be put down so as to be used in future. The boilers, engines, stations, network and house distribution plant could all be retained, and the only loss in changing to the battery system would be the alternating dynamos and transformers ; both of which together would not cost more than 10s. a lamp. The wiring and fitting of each lamp in a private house would cost at least 30s. to 35s., the conductors about 30s., making the possible future sacrifice nor more than 10s. per lamp, altogether, in any installation costing originally £3 and more per lamp. Nearly the whole plant would remain serviceable until the day arrived when batteries could be used, and until then the alternate current transformer system would be found good enough, and safe and reliable for all practical requirements.

Mr. Mackenzie said there could be no gainsaying the fact that the transformer system had made tremendous way and this would never have been so if it did not possess merits placing it before all others for electric distribution. He quite expected to see Mr. Crompton soon advocating it as warmly as he had, not many years ago, opposed distribution by secondary batteries.

Infringement Suit against the Brush Company.

George H. Seeley and others have commenced an infringement suit against the Brush Electric company and another. The complaint in substance sets forth that in 1874 Matthias Day obtained a patent for an electric light improvement. Subsequently he disposed of an undivided half interest in the invention to George H. Seeley, George I. Stevens and Nathan Seeley, of New York. Afterward he assigned the remaining interest in the patent to the Western Electric company of Chicago. These joint owners of the patent institute this suit asking for an accounting and an injunction against the defendant company.

Claim 1 of Day's patent is as follows: "In an electric light the combination with each electrode holder and one electrical circuit of two or more electrodes substantially as and for the purpose set forth."

The Day patent is said to be the first United States patent in which two sets of carbons are shown. When the current is established the arc forms at one of the sets only. This set burns until its resistance becomes so great that the current is broken and the arc shifts to the other

pair. The latter are then burns until its resistance too becomes so great that the arc shifts back to the first pair. The different pairs burn thus alternately, shifting once in about ten minutes.

In the Brush lamp which it is alleged infringes on the Day patent, the different pairs of carbons are arranged in multiple circuit as in the Day lamp. The lifting and feeding mechanism of the Brush lamps is such however that one set of carbons is entirely consumed before the other begins to burn.

The case is instituted in the United States circuit court at Chicago. John R. Bennett, of New York and George P. Barton, of Chicago represent the complainants and Henry H. Seymour, of Washington and Leverett L. Leggett, of Cleveland will appear for the defendants. The suit, which is one of the greatest importance, will be sharply contested. The trial will probably not commence before next fall.

CORRESPONDENCE.

New York Notes.

New York, April 14.—Members of the New York Electric club are looking forward with interest to the exhibition of the Edison phonograph by E. T. Gilliland, at the club rooms next week. A public exhibition is also arranged for to which members of the New York press will be invited. So those who may not be able to see the wonderful machine next week may count on having much definite information about it. Mr. Gilliland states that the first lot is nearly finished in the Edison shops, and that that they will soon be on the market.

In no other branch of the electrical business it seems is there so great activity as in the manufacture of high insulation wires. The Bishop Gutta-Percha company have greatly increased their plant and have added a rubber compound to their specialties, an insulation especially adapted for leading in electric light wires and other uses where rubber insulation is more desirable than gutta-percha. Holmes, Booth & Haydens are doing an enormous business with their "K. K." and other wires, and that the Day kerite wire holds its own in the market goes without saying. The Okonite, Grimshaw and Callender companies report that they are running their factories to their full capacity with orders ahead all the time, also the Ansonia Brass and Copper company, and the Edison Machine works.

A fire in the third floor of the factory of the Empire City Electric Co., at 15 Dey street, made matters look serious for a few minutes day before yesterday, but thanks to the prompt action on the part of the fire insurance patrol service it was put out without causing much damage. That the fire did not reach the store is fortunate, as the Empire City company carry a large line of goods in stock.

The New Haven Clock company have moved from Park Place to 29 Murray street and are nicely settled in their new quarters. J. H. Noyes, manager of the electrical department of the company reports business most satisfactory, particularly in the line of their new style Morse instruments. He has recently issued a new 72 page catalogue, fully illustrated, which is sent to any address upon application.

It is generally conceded that the last meeting of the National Electric Light association was in many ways the most successful one ever held. Quotations from papers read there are still going the rounds in the daily press, showing a popular interest in electrical matters and that the topics treated of at Pittsburgh were live ones.

The Herzog and Gamewell companies were principal competitors in the recent contest for the New York police patrol service contract, which was finally awarded to the Herzog Teleseme company. Quite a stiff breeze has been raised in the police board by allegations by Commissioner Voorhis that there was a "job" in the matter and that attempts were made to influence him. At a stormy meeting held yesterday resolutions were passed requiring him to prove his statements.

The Third Avenue surface road will run its cars by cable; permission has been granted by the city authorities to construct the road and ground will be broken at once. With elevated and cable roads on Third avenue, and electric and horse cars on Fourth avenue, there will be opportunity for comparison of the different methods of transportation.

E. M. Barton, President of the Western Electric Co., and Prof. Badt, of the U. S. Electric Lighting Co., have been in the city this week. A.

Indianapolis Items.

Indianapolis, April 14.— Electricity is to be used by the Lafayette, Indiana, street railway, the necessary permission to erect poles and string wires having been granted by the council.

It is rumored that the Postal Telegraph company are to put in printing instruments here to furnish base ball reports to subscribers. It is doubtful whether such service could be made to pay as too many firms get telegraphic reports of games by innings and post them in show windows.

The city civil engineer has prepared specifications for lighting the city by electricity, and is ready to furnish copies to any one interested. The terms include the following: The contractor to furnish all necessary material and work for a substantial electric plant ready for operation, and to operate the plant for a trial period of sixty days after completion. If the trial should prove satisfactory, the city to accept the plant, rental to date from the beginning of trial period. The equipment must be of the most approved design and the light as good as the best of its kind in the United States. Bidders will make their propositions upon three plans of lighting: (1) On what is known as the moonlight schedule, or 2,500 hours, including also such nights as when the moon is obscured by fog or clouds; (2) For a time schedule of 2,740 hours; (3) For all-night lighting for every night in the year, or 3,750 hours. Propositions will be received for suspending the wires and for placing them underground, and for lighting the alleys. The territory to be lighted embraces an area of about 4,310 acres, in which are 2,644 gas and 241 oil lamps. Alleys may be lighted by manufactured lamps of not less than sixty-five candle-power. The street arc lights must be of 2,000 candle power, not more than fifty to be lighted by any one circuit. The contractor is required to give bond, and his bid must be accompanied with a certified check for $5,000, payable to the mayor. Bidders must state the amount of annual rental for lighting the city for a term of one, two or three years; also to state a price for the entire plant complete, in case the city desires to purchase the same at the end of three years, the time for completing the contract shall not exceed six months.

The following companies have already applied for information: The Thomson-Houston company, the Charles T. Armstrong company, the Terre Haute, Ind., Electric Light company, the Westinghouse company, the Brush company, the Waterhouse company, the Heisler Electric company, the Jenney company of Fort Wayne and the Jenney company of Indianapolis.

The city has something over 2,700 gas lamp posts; it has been suggested they might be utilized in lighting the streets with incandescent lamps, otherwise they will be almost a dead loss.

M.

From the Pacific Slope.

San Francisco, April 13.—Three superintendents of fire alarms have been appointed within as many months and still dissatisfaction exists.

The employes of the California Electric Light company have been uniformed. Their caps have gold lettering giving their positions.

Two messenger boys have recently gone astray. A boy in the employ of the American District Telegraph company was detected while endeavoring to file open the money drawer. The other messenger, who was employed by the San Francisco District Telegraph company, was entrusted with a package containg $200. He decamped and was found at Los Angeles.

A resident of this city has discovered a method of utilizing electricity in the tanning of hides. The experiments indicate that the same results now secured by the use of tanbark, acids, etc., can be produced at 50 per cent. of the present cost and in a manner every way more convenient and satisfactory. Tanbark is done away with altogether by the new methods, the inventor substituting for it a material which he can manufacture on the spot at a merely nominal cost. The electric current, however, is the main agent in the tanning process. By the new method, it is claimed, all injury to the hide is completely avoided, the fibrous tissue being preserved uninjured, which will add greatly to the strength of the leather.

Governor Waterman is highly pleased with the electric light plant at San Quentin prison, enabling the authorities to work a night force. Warden Charles Hull recommends that dynamos which can be driven by water power be installed at the Folsom prison.

The electric lights in the Spring Hill mines have proved so satisfactory that the Wildman mining company has decided to employ incan descent lights.

The city council at Visali have made a contract with the Visali Electric and Gas company to light the town by electric light.

The Oakland Gas and Water company has contracted for twenty-five one-horse power motors and will organize a motor system. S.

From Woodland, Cal.

Woodland, Cal, April 10.— In January, 1886, Mr. Cheeney came to this place, says the *Mail*, describing the illuminating systems of the town, and, after making a thorough inspection of the place, he consulted with some of our leading citizens and soon succeeded in forming a joint stock company for the purpose of introducing electric light to take the place of the gas then in exclusive use, first placing on exhibit a nine-light dynamo to illustrate the satisfactory working of his electric system. The shareholders, generally, went into the enterprise as a matter of public pride, and Mr. Cheeney staked all his means and his interests in the venture, having confidence that in time the enterprise would prove profitable. Not succeeding in securing sufficient capital to more than purchase the electrical apparatus, power was for a while furnished by the flour mill. The dynamo was started upon March 20th. The works were run in this way for about a year, when, on account of insufficiency of power furnished and very unfavorable surroundings, on Mr. Cheeney's proposition to lease the entire plant of the company — guaranteeing a fair return on the investment if new works were built — it was decided to erect a station for the exclusive use of the plant. Ground, 100 by 150 feet, was bought on Sixth street, on which was constructed a brick building, 30 by 60 feet, having a coal room 30 by 30 feet, the work being done by David Scott and Glenn & White, and having a hard wood floor and red wood ceiling, all oiled and polished. The roof is of corrugated iron. A boiler, 80 horse power, from the Risdon Iron and Locomotive works, San Francisco, and a 60 horse power engine of the Armington & Sims Manufacturing company, of Providence, R. I., with a Hooker pump and Monitor injector, for feeding the boiler, were put in to run the machinery. Another 45 light dynamo and lamps were bought and since that time a number of incandescent lamps of 65 candle power each having been added, giving the plant a capacity of 100 lights. Every piece of machinery connected with plant is polished and much of it is of nickel and brass. The engine is of the piston balanced valve type and runs 275 revolutions per minute. The electrical apparatus is of the Thomson-Houston patent, pronounced by all to be the best now in use. By means of the controller and regulator, which work automatically, no accident can happen from burn-outs as in all other systems, and any number of lamps can be maintained from the minimum to the maximum of the capacity of the machine, preserving the same intensity without changing the speed of the engine, effecting a great saving in power. So thoroughly was the work of installation of the electrical and steam plant, and so careful and competent is Mr. Cheeney, that from the day of starting the new station there has not been a stop of any kind not for even a minute, and the lamps have never failed from the time darkness came till the circuit is opened at shutting down time.

The plant is pronounced by people who have traveled and observed the working of others to be the most complete and perfect, and the qual-

ity of light furnished, superior to any other on the coast. Mr. Cheeney takes a commendable pride in looking after every piece of machinery and the interior of the station is a model of order, taste and neatness.

In January of this year Mr. Cheeney entered into negotiations for the lease of the gas works but soon after, before the lease was effected, the principal stockholders of the electrical light company secured by purchase the controlling interest in the gas works on Mr. Cheeney's proposition to also lease and guarantee a reasonable income on the investment. Following came the reincorporation of the two companies under the name of the Consolidated Electric Light, Gas and Power Co., with a capital stock of $35,000, and all the property of the corporation has gone into Mr. Cheeney's hands to manage under his lease for a term of years. Since assuming control of the gas works department Mr. Cheeney has shown no disposition to abuse the position he is in by running prices to a fancy figure, but rather he is sensible and just enough to derive only a fair compensation for his services and risks. C.

Personal Paragraphs.

E. W. Godfrey, formerly of Boston, Mass., is now connected with the Edison company in Chicago.

E. S. Hewson of the United States Electric Lighting company of New York will take the place made vacant in the western office of that company by the resignation of Prof. F. B. Badt.

E. M. Barton, president of the Western Electric company is in the East superintending some matters relative to the new building about to be erected at the corner of Greenwich and Thames street, New York. The building will be nine stories high and will be a model one in every respect.

Captain Griffin, late of the United States engineers office, was called upon by the government for a report upon the electric railways of the United States. The report was so masterly as to attract the attention of the Thomson-Houston Electric company to the degree of securing the captain's services. The captain entered the employ of the company April 10th and will be in charge of their electric railway business, an office, by the way, quite distinct from the charge of the motor business.

Forée Bain is about to remove his place of residence to Argyle Park, Ill. One of his chief reasons for making the change is to secure a place for a laboratory free from the vibration and other disturbing influences of the city, where he can conduct delicate experimental or test work. Mr. Bain will not give up his business at 76 Market street, Chicago, but will use his private laboratory as an accessory to his facilities and do work at the latter place that would not be practicable in the city.

A. H. Parker, who has been connected for some months past with the Austin Water, Light & Power company, has received the appointment as state agent, or representative, in Texas for the Brush Electric company of Cleveland, O., with headquarters at Dallas, and in future will have charge of that company's entire business in Texas. The appointment is a most excellent one. Mr. Parker is a young gentleman of fine business qualities, excellent address, and will make friends wherever he goes. The *Dispatch* congratulates him as well as the company.—*Austin Dispatch.*

THE ELECTRIC LIGHT.

Booneville, Mo., will vote on the electric light question May 8th.

The Paris, Tex , Electric Light company will soon enlarge its plant.

The Ionia, Mich , Electric Light company has been incorporated with $25,000 capital.

The Baraboo, Wis., Gas & Electric Light company has been organized with $30,000 capital.

It is said that the Maumee, O., Gas company will extend its system by adding an electric light plant.

The Thomson-Houston company is to install a plant of 35 arc and 650 incandescent lights in Sioux City, Ia.

The Wheeling, W. Va., board of gas trustees is considering the advisability of purchasing an electric light plant.

The question of establishing a gas and electric plant is being considered by a committee of the Baltimore common council.

Chief Walker, of the electrical bureau of Philadelphia, recommends that the tower system be examined if all wires cannot be placed under ground.

The Industrial Society of Amiens has offered a prize for an essay on the subject, "The best electric light installation in an industrial factory."

An electric exchange has been formed in Boston. It will issue licenses to employes of electric light companies. P. H. Alexander is president and H. B. Cram secretary.

Mayor Roche, of Chicago, has directed Prof. Barrett, city electrician to prepare plans for lighting by electricity Clark street from the river to Van Buren street and Madison street from Michigan avenue to Halsted street.

In the report of the department of public works of Chicago submitted to the common council, Commissioner G. B. Swift speaks of the satisfactory working of the Chicago river electric light plant and recommends its extension.

The city council of Atlanta, Ga., estimates that the probable cost of a combined electric light and water-works plant for the city will not exceed $40,000, and perhaps it can be accomplished for $35,000. The citizens favor improvements of this kind.

The electric light company at Dennison, Tex., whose plant was recently burned out has ordered a 40 light and a 60 light machine of the Van Depoele company. The company is an enterprising one and proposes to be engaged in active business again as soon as the facilities can be provided.

Last Sunday morning a boy leaning against a telegraph pole on East Broadway, New York, was stunned by a current of electricity and died soon after. The current came from an electric light wire which had crossed a telegraph wire and was communicated to the unfortunate lad by means of a loose wire wound about the pole against which he was leaning.

An elaborate electric light plant has been installed on the steam yacht Wanderer, a magnificent boat owned by the Prince Tartonia of Rome. A Willans' compound central valve two crank engine of 12 indicated horse power is coupled direct with the dynamo which is driven at the rate of 445 revolutions per minute. The accumulator has a capacity of 630 ampere-hours. A search light of 2,000 candle power is fitted on the navigation bridge and a gangway lamp of 200 candle power is suspended over the ship's side from a davit.

A company of citizens have organized an electric light corporation for the purpose of illuminating a section of the south division says the Chicago *Daily News*. They propose to furnish street lamps free and to give the city 2 per cent. of their profits on private business. One would suppose there would be no question as to the propriety of granting them this privilege. Unfortunately, however, a corrupt monopoly has conflicting interests, and the odds are ten to one that the city aldermen will vote for the monopolists. We shall be surprised if it be not so.

The following description of electric lighting on the Midland railroad is taken from the London *Electrical Engineer:* The system secures "through lighting" in a train by the adoption of the Union battery stored in each vehicle, and by this means any coach may be slipped from a train without interfering with the maintenance of the light. In case one of the coaches breaks loose from a train, the lamps in them, if lit, remain lighted, and if they are not lit provision is made for their being automatically lighted. The controlling circuit switches the light on or off at will, though at all times the state of the lighting circuit is such that, should a carriage break away, the lamps are automatically lighted. The lamps used are 5 candle-power Swan lamps, two to each carriage, and these are arranged below reflectors, that aid in the equal distribution of light through the whole carriage.

The accumulators or storage batteries used for lighting the Pullman cars running between New York and Chicago are, after ten months' cons ant use, still doing good practical service, notwithstanding the fact that they have been repeatedly over-discharged and injured in consequence. It seems the number of cells was not sufficient for the work required of them, a fact of which the accumulator company did not become aware till after the discovery of the injury by over-discharging, and which can be easily provided against in the future by the addition of more cells. But the practical results of the ten months' trial in this severe railroad service, the most severe for which such batteries can be used, are highly satisfactory, both to the Pullman company and the accumulator company; having fully equalled the most sanguine hopes entertained in regard to this experiment at the outset; demonstrating its entire practicability, and the durability of the accumulators for practical service, which was only partially assured a year ago, and concerning which grave doubts were then entertained by electric business men.

The manufacture of arc light carbons forms an industry of considerable magnitude in Vienna, and the works of Herr Hardtmuth in Döbling, are now turning out about 3,500 metres of carbons daily. Some improvements have recently been made in the process of manufacture, under which the homogeneity and density of the carbons are increased. These refer more especia ly to cored carbons. As usual, the rod of plastic material issues from the press in the form of a tube, and after drying and baking, the carbons are steeped in a heavy hydrocarbon, by which the pores left after the first baking are filled. The carbons are again baked, and the core is then inserted under a pressure not much greater than that of the weight of the plastic mass forming the core. In connection with this factory is a well equipped electrical laboratory for the testing of arc lamps. A spectroscope is used for determining the elements contained in the carbon from the spectrum of the arc, and the laboratory is equipped with the usual electrical measuring instruments and photometers. The work at this laboratory is done on a thoroughly scientific basis, and both lamps and carbons are tested so as to determine the best quality of carbon to be used for each type of lamp.

THE ELECTRIC MOTOR.

The organ at St. John's Church, Taunton, England, is to be blown by electricity.

The electric motor has been successfully employed by M. Taverdon, to operate rock drills.

At Louisville, Ky., T. F. Gayner, W. R. Ray and others propose to form the Ohio Falls Electric Water Power company, with a capital stock of $2,500,000.

The Van Depoele company of Chicago is still constructing motors and will continue the work several months yet until the contracts made before the transfer of the motor business to the Thomson-Houston company was negotiated are completed. The company is also making several motors for the Thomson-Houston company.

The boat race of 1888 may be remembered as the first in which the electric launch has made its appearance on the river. In a few years we shall doubtless find that for purposes of pleasure the steam launch will have well nigh disappeared, for no one who has once experienced the comfort, pleasure, and handiness of an electric launch will ever again be content with its noisy and dirty predecessor. It should therefore be welcome news, not only to electricians but to all who are interested in the river, to learn that Messrs. Immisch are making active preparations for the establishment of floating charging stations on the Thames.—*London Electrician.*

The service on the short experimental electric street railroad in Vienna from the Central Station along the Koenigsgasse and part of the Ringstrasse, has for some months been perfect. The current is supplied by means of a central channel and a pair of conductors, against which slide two contact shu tles. There are at present only two cars in use. The transmission of power from the motor spindle to the car axle is by steel wire spiral cords. The central channel is of masonry throughout, with cast iron chairs for the support of the conductors, and has two steel rails on the top, leaving a slot 1¼ inches wide. Manholes are provided in several places to give access to the channel, and efficient provision is made for draining it. Messrs. Siemens and Halske, who have built this line, are now experimenting with various forms of contact shuttle. They have asked for a concession to extend the line the whole length of the Grosse Ringstrasse, now building, and they also made an offer to the town authorities to build, and equip with electric apparatus, several tramway lines which were originally projected for steam traction. In all cases they ask that the usual concession of forty years should be prolonged to fifty years, the extension of time being justified by the heavy initial outlay for the permanent way.

THE TELEPHONE.

The Western Electric company has just shipped to Portland, Ore., a multiple switchboard of the single cord pattern. It is equipped for 800 lines.

Stockholm has one of the most perfect telephonic exchanges in Europe and it is said that its percentage of subscribers is the largest of any European city.

The Supreme court has advanced the case of the United States against the Bell Telephone company and set it for hearing the second day of the next term. It will now come up next October. The case is the original one brought two years ago against the Bell company in Ohio by Attorney General Garland.

Linemen of the New York and New Jersey Telephone company were raising a 40-foot pole over the Pennsylvania railroad tracks near Bay street, New York, recently, when engine 629 ran into the end of the pole and drove it up the street like spear. It broke an iron lamp-post and a fire hydrant off at the ground Two men who were passing escaped death by jumping into the hallway of a tenement.

The following press despatch describes a successful long distance telephone experiment last Sunday: The train dispatcher's office of the Chicago & Alton in Bloomington, Ill., was connected with Kansas City, the Western Union wire number 40 being used. This is a copper wire weighing 210 pounds to the mile. The new long distance transmitter of the Bell Telephone company was used here, with six ordinary cells of Callaud battery. Kansas City used a similar transmitter with four ordinary cells of Leclanche battery. The conversation between Bloomington and Kansas City was carried on as readily and perfectly as on a quarter-mile circuit with the ordinary Blake transmitter. Kansas City next extended the circuit to Topeka, Kan., and St. Joseph, Mo., and conversation was carried on as readily as before. The distance is 370 miles to Kansas City, making the longest circuit utilized something over four hundred miles. The atmospheric conditions were perfect.

THE TELEGRAPH.

Twelve bills are before congress providing for a governmental telegraph.

The block in which was located the Western Union Telegraph office at Middlesburg, Vt., was destroyed by fire last week.

The miles of telegraph lines in the world aggregate according to the New York *Graphic*, 743,096. The mileage of the United States is 231,588. The number of miles of lines owned by governments is 430,029.

The Chicago *Tribune* last week discontinued its business with the Western Union Telegraph company and decided hereafter to employ the Postal Telegraph company's lines. The change was brought about by a disagreement between the managers of the Telegraph company and the proprietors of the *Tribune*. There were eight Western Union operators at the *Tribune* offices.

The British government, it is stated, will soon inaugurate in England and Ireland a system of telegraph money orders to be governed by the same rules as those of the money

order department of the post-office. The plan provides for transmitting orders by telegraph for the payment of sums not exceeding £10 for each order. The cost over that of an ordinary money order to go by mail will be the usual charge for the message. In this country a fee of not less than $1 is exacted, however small the sum to be transmitted may be, and then the regular price for sending the message is charged in addition. To telegraph $2.50 to New York from Philadelphia co ts at least $3.75, or one and a half times the amount to be transmitted ninety miles.

In Baltimore last week Judge Duffy, in the Circuit court, decided the case of the Southern Telegraph & Cable company of New York against the United Lines Telegraph company, Francis P. Stevens, Wm. A. Dunn and others in favor of the complainant. The suit was brought in July, 1886, by the complainant corporation, to have the property of the Bankers' and Merchants' Telegraph company, which was sold by the receivers in December, 1885, conveyed to this company, it having paid the entire amount of the purchase money, $25,000. Owing to a misunderstanding at the time of the sale, the receivers insisted upon reporting the United Lines Telegraph company as the purchaser. The suit was brought to correct this, and was resisted by the defendants on the ground that they were creditors of the United Lines. Judge Duffy decided that the Southern Telegraph & Cable company was the real purchaser of the property, and passed a decree directing the property to be conveyed to the complainant free from all claims of the defendants.

Business Mention.

Holmes, Booth & Haydens report large sales of their "K. K." wire for electric railroad purposes. The proprietors of electric roads desiring to profit by the experience of those who have engaged in electric lighting, propose to guard against the evils resulting from poor insulation.

The Electrical Construction company of Chicago have moved to larger and more convenient quarters at 175 Randolph street, second floor. The capital stock has been increased to $25,000 and the facilities greatly enlarged. The officers are: N. Harter, president; G. A. Harter, secretary; Mr. Whipple, treasurer.

Ernest Anthony, electrician, writes from Brainerd, Minn. that his company is using the Thomson-Houston arc system and that it gives "better satisfaction than any system he has ever handled." He continues, "we are going to put in another Thomson-Houston dynamo and an incandescent plant of the Westinghouse alternating system of 2,000 lights."

The Shultz Belting company, of St. Louis, have recently received an order for a belt 35 inches wide and 140 feet long from the Lancaster Mills in Massachusetts. These mills have been using the Shultz belting since 1881. They go a long ways from home, but they know where to get good belting. The Shultz Belting company is running night and day to keep up with their orders.

C. F. Dunderdale, of the Chicago office of the Waterhouse Electric & Mfg. Co., reports business with that company as very satisfactory, and that the public interested in electric lighting business are beginning to appreciate the merit, efficiency and economy of the Waterhouse systems, and are willing to pay a higher price than asked by competitors, as an economical investment in the long run.

F. W. Horne, Western agent of the Excelsior Electric Light company is receiving congratulations upon a handsome contract he has just taken from the Union Stock Yards and Transit company of Chicago, to light their entire yards. There will be two 30 light arc dynamos, double carbon lamps, and 7½ miles of circuit. The contract also calls for the steam plant. The engine will be an Ide of 70 horse power.

The Thomson-Houston Electric company have recently booked orders as follows: Eaton Rapids, Mich., 30 arc lights; Joplin, Mo., 50 arc lights; Oswego, Neb., 30 arc and 500 incandescent lights; City of Jackson, O., 35 arc lights; Sioux City, Ia., Electric Light company, 35 arc and 650 incandescent lights; Lawrence, Kan., 60 arc lights; Cleburne, Tex., 35 arc lights; Pella, Ia., 300 incandescent lights; an additional order for 30 arc lights for Houghton, Mich.; Kalkaska, Mich., 30 arc lights; an additional order for 35 arc lights for the Akron, O., Citizens Electric Light company; Wahpeton, Dak., 30 arc lights; Union City, Ind., 50 arc lights; and Ionia, Mich., 30 arc and 500 incandescent lights.

Electrical Patents.

Issued April 10 1888.

380,702. Dynamo. Henry B. Slater, Detroit, Mich

380,752. Telephone Transmitter. Isaiah H. Farnham, Malden, Mass.

The invention relates to transmitters which contain granulated carbon and is designed to prevent the carbon from packing. The case is provided with an elastic or extensible bottom and means for adjusting said floor or bottom by expanding and raising its centre so as to diminish the carbon holding space thus pressing the carbon therein up against the upper surface of the diaphragm.

380,757. System of Electrical Distribution. William H. Hart, Brooklyn, and James T. Goodfellow, Troy, N. Y.

The invention consists in apparatus for distributing the cables and wires in the conduits containing them, and in the manholes which are interspersed along the lines of the conduits. A complete system is illustrated in eight sheets of drawings. The claims, thirty-four in number, cover the constructions shown.

380,765. Electric Accumlator. John M. Pend'eton, New Brighton, N. Y.

380,766. Electric Cut-Out. Charles G Perkins and John Tregoning, Hartford, Conn.

380,778. Municipal Telegraph Apparatus. John C. Wilson, Boston, Mass.

The invention consists in providing the boxes with indicating signals that can be controlled in the central office and the operation of which preferably can be perceived from the outside of the box, so that the policeman on coming to the box can tell at once and without opening the box whether anything is wanted of him, and if not he can continue his round without having to open the box and transmit a signal as would otherwise be required.

380,779. Municipal Telegraph. John C. Wilson, Boston, Mass.

380,780. Telephone and Signaling Circuit. John C. Wilson, Boston, Mass.

380,817. Electrical Governor. Frank E. Prichard, Cedar Falls, Iowa.

380,824. Electrical Speed Indicator. Frederick W. Schlepegrell, Charleston, S. C.

380,829. Electrical Hand Cord Tip. Henry J. Swarts, Detroit, Mich.

380,842. Apparatus for Examining Ores. John R. Williamson, Seattle, Wash., and William W. Hickies, Oakland, Cal.

380,845. System of Electrical Translation. Reginald Belfield, Pittsburgh, Pa.

The object of this invention is to provide means for securing such automatic regulation as to at all times insure a desired difference of potential on the working circuit throughout the variations of resistance therein, and further to render it possible to diminish or increase the brilliancy of the lights, as may be desired, and having the required brilliancy to render it constant.

The third claim is as follows: "The combination, with a source of electric currents and translating devices, of two converters having their primary coils connected with said source in multiple arc with each other and their secondary coils connected in series with each other and said translating devices, and means for modifying the effective action of the core of one of said converters upon its coils."

380,846. System of Electrical Translation. Reginald Belfield, Pittsburgh, Pa.

Claim 4 reads: "The combination, with a source of electric currents and a circuiit therefor, converter having its primary coil connected in said circuit, translating devices connected in the secondary circuit of said converter, a soft iron core, and two coils applied thereto, one of said coils being connected in series with said primary coil and the other in multiple arc with said secondary coil, means for altering the relative action of said soft iron core and its coils, and one or more converters in multiple arc with the first-named converter"

380,855. Galvanic Battery. Horatio J. Brewer, New York, N. Y.

380,856. Galvanic Battery. Horatio J. Brewer, New York, N. Y.

380,879. Electric Locomotor. Stephen D. Field, Yonkers, N. Y. Claims 4 and 15 are given.

"4. The combination, with the driving wheels of a vehicle, of crank pins upon the same, a horizontal link connecting the crank pins, an electric motor mounted upon the axles of said wheels, having its axis in the plane of the axes of the driving wheels, a crank upon the shaft of the motor, and a vertically yielding connection between the crank and said link.

"15. An electric circuit controller consisting of a series of contact springs, a contact surface in the form of a segment of a cylinder, a shaft upon which it is loosely mounted, a knee joint connecting the same with the shaft, whereby one edge may be thrown a greater or less distance from the shaft, and a non-conducting striking surface for the spring."

380,880. Electric Locomotive. Stephen D. Field, Yonkers, N. Y. Claim 1. follows:

"The combination, with an electric motor, of a vehicle carrying the same and supported on springs, a crank arm at each end of the armature shaft set at an angle with reference to each other, crank arms upon the wheels upon opposite sides of the vehicle, coupling bars connecting the respective cranks of the motor with the cranks of the vehicle wheels, supporting bars between the axle of the motor and the driven axle, and links connecting the respective vehicle wheels with other vehicle wheels upon the corresponding sides."

380,905. Electrical Telephone. F. Du Pont Morston, Philadelphia, Pa.

The carbon diaphragm has a wire conductor, extending entirely around it and leading to one pole of the battery, the other electrode being a loose carbon rod or ball resting upon the diaphragm and connected to the other pole of the battery in the usual manner.

The third claim is as follows: "In a telephone, a horizontal traveling diaphragm having a peripheral connection for one conductor, a gravitating electrode being sustained in a dust tight guide tube."

380,922. Electrode for Secondary Batteries. Richard Packer, Chester, Pa.

380,925. Microphone Transmitter. George M. Phelps, Brooklyn. Filed Oct. 2, 1879.

The invention consists in placing the diaphragm in a horizontal position above a downwardly flaring mouthpiece, in a diaphragm made of alternate disks of soft paper and thin metal cemented together, and in mounting a standard on the center of the diaphragm, and securing an inertia-weight to a spring fastened on the standard, the weight carrying suitable contact pieces with devices for adjusting the degree of pressure or area of the contact surfaces mounted on the standard.

380,942. Electric Indicator. Oliver B. Shallenberger, Rochester, Pa.

The invention consists in deriving from the main circuit currents having a potential directly dependent upon the difference of potential at the terminals of the generator, and currents upon a second circuit having a potential dependent upon or effected by the loss or drop upon the lines where that loss is sufficient to cause an appreciable effect on the work-circuit. The effects of the currents thus derived are balanced against or caused to oppose each other, and the resultant indicates the difference of potential existing upon the work-circuit.

380,943. Volt-Ammeter. Oliver B. Shallenberger, Rochester, Pa.

Claim 1 follows: "An ammeter for alternating or pulsatory currents, consisting of the combination with a voltmeter, of an electric converter having its primary coil connected in series with the work circuit and its secondary coil connected through said voltmeter."

380,944. Electrical Pressure Indicator. Oliver B. Shallenberger, Rochester, Pa.

Claim 4 is given: "An electric indicator consisting of two opposing coils, a metallic resistance, in circuit with one coil, a resistance varying with the quantity of current traversing it in circuit with the second coil, a third coil, and an indicator acted upon by the resultant effects of the three coils."

380,945. Adjustable Inductive Resistance. Oliver B. Shallenberger, Rochester, Pa.

The object of the invention is to provide a convenient form of adjustable inductive resistance, the value or effect of which may be increased as the core is withdrawn from the coils. The invention consists in applying to the core of soft iron oppositely wound coils of insulated wire, which have equal and opposite effects upon the core when the latter is in its normal position, thus producing no inductive resistance. As the core is withdrawn, however, it is gradually removed from the field of one coil, and thus the value of the other coil greatly increases until its full effect is obtained. The device is further provided with a short-circuiting switch or cut-out, which serves to short-circuit the coils when the core is in its normal position.

Claim 1 reads as follows: "The combination, with an incandescent electric lamp and a circuit supplying currents thereto, of an adjustable inductive resistance for turning down the lamp, consisting of magnetizable material and opposing coils of wire wound about the same, both of which are normally included in circuit."

380,946. Central Station for Alternate Current Systems of Electrical Distribution. Oliver B. Shallenberger, Rochester, and Henry M. Byllesby, Pittsburg, Pa.

380,947. Electrical Indicator. Oliver B. Shallenberger, Rochester, Pa. We give claims 1 and 7:

"1. An electric indicator consisting of two coils opposing each other, one coil receiving currents dependent upon the potential at the terminals of the source of electricity and the second receiving currents dependent upon the current in the work circuit, and an indicating device operated by the resultant effect of said currents.

"7. An electric indicator consisting of a converter, the primary coil of which is designed to be connected in an electric circuit, means for adjusting the active length of the conductor constituting the secondary coil, a solenoid included in the secondary circuit, a second solenoid acting in opposition to the first-named solenoid, and an indicator affected by currents traversing said solenoids."

380,971. Construction of Stationary and Itinerant Electrical Batteries. James T. Armstrong, London, England.

Claims 3 and 6 follow: "3. A galvanic battery electrode or element formed of tinned scrap iron molded or pressed into the desired shape."

"6. A perambulating or itinerating electrical apparatus comprising a car or wagon having a depressed center forming a passage way, the battery cells arranged at the sides of said passage way, and the movable supply and stationary feeding cisterns arranged at one end of the car.

380,989. Secondary Battery. Hiram H. Carpenter, New York, N. Y.

Claims 1, 4 and 13 are given: "1. A hollow electrode composed of alloy containing lead and silver and a body of active material within the same.

"4. A hollow electrode for secondary batteries, adapted to receive the active material within it, having a movable cap covering its top.

"13. In a secondary or storage battery, in combination with the positive and negative electrodes composed of lead and silver and provided, respectively, with oxide of lead and silver and carbonate of lead and silver as active materials, the electrolytic liquid."

381,004. Apparatus for Forming Sheets of Nickel or Other Metal by Electrolysis. Moses G. Farmer, Eliot, Me.

381,048. Contact Making Device for Electric Railways. Frank Wynne, Westminster, County of Middlesex, England.

381,054. Alternate Current System of Electrical Distribution. Henry M. Byllesby, Pittsburg, and Oliver B. Shallenberger, Rochester, Pa.

A number of dynamo electric generators are employed—say four in number. These have their field magnets supplied by currents from two separate exciters, each provided with its own driving engine. The field magnets are connected in multiple arc with their respective exciters and the generators are independently regulated.

We give claim 2: "The combination, with two independently driven electric generators, of two or more alternate current generators having their field-magnet coils normally supplied from said generators, respectively, switches for placing the field magnet coils of the alternate current generators either independently or jointly in connection with either or both of the first named generators, and means for regulating the strength of the current from the latter generators."

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Notice is hereby given that sealed proposals will be received by the Common Council, of the city of Indianapolis, Indiana, up to 8 o'clock p. m., of the 7th day of May, 1888, for lighting the city with Electricity.

Specifications for the above work are now on file in the office of the City Civil Engineer, and can be had on application.

S. H. SHEARER, City Civil Engineer.

C. F. ANNETT, President. S. F. FENTON, Vice-Pres. and Treas. CHAS. S. SMITH, Secretary.

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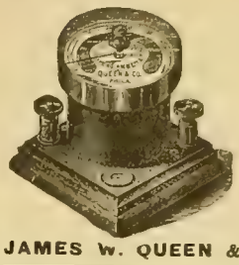

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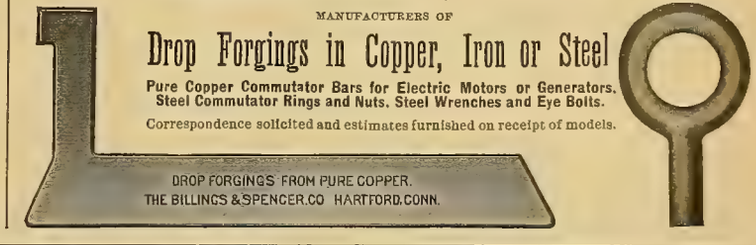

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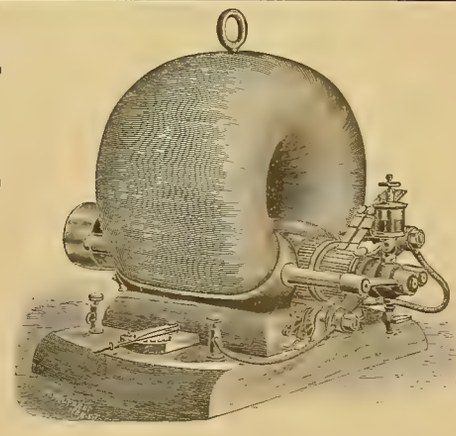

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F. T. HASKINS,
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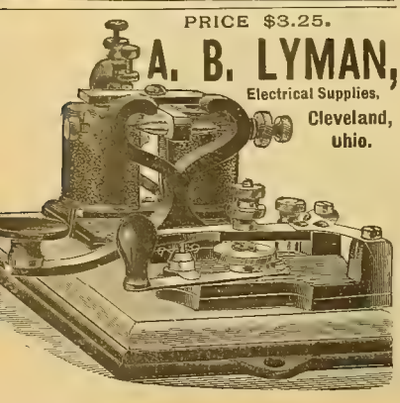

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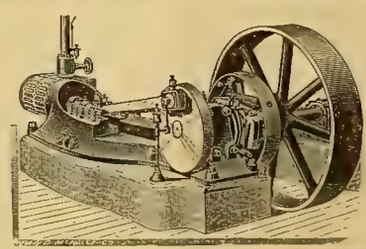

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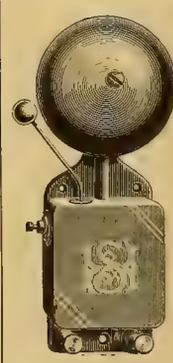

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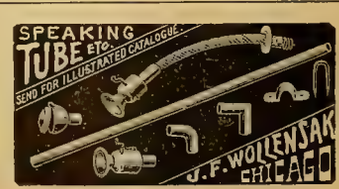

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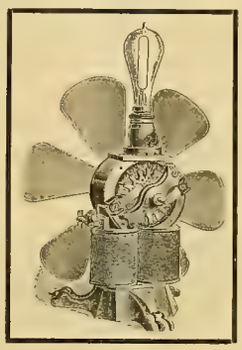

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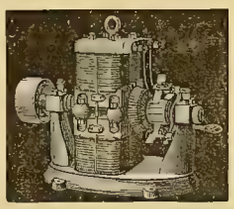

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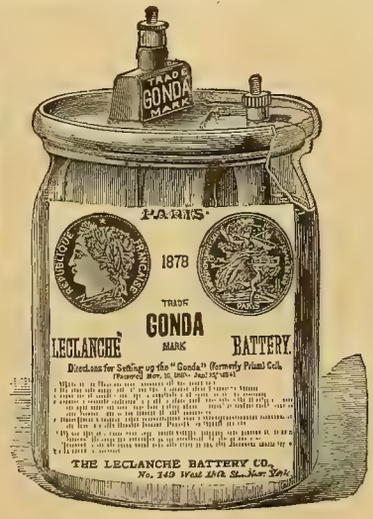

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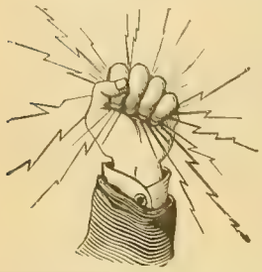

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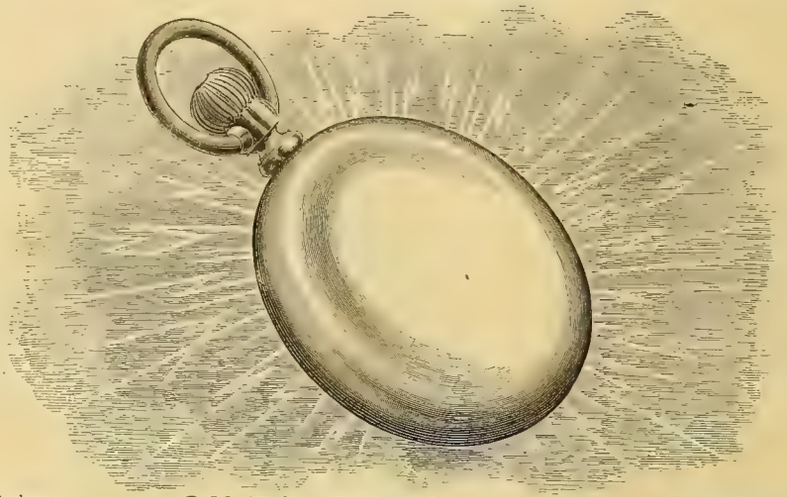

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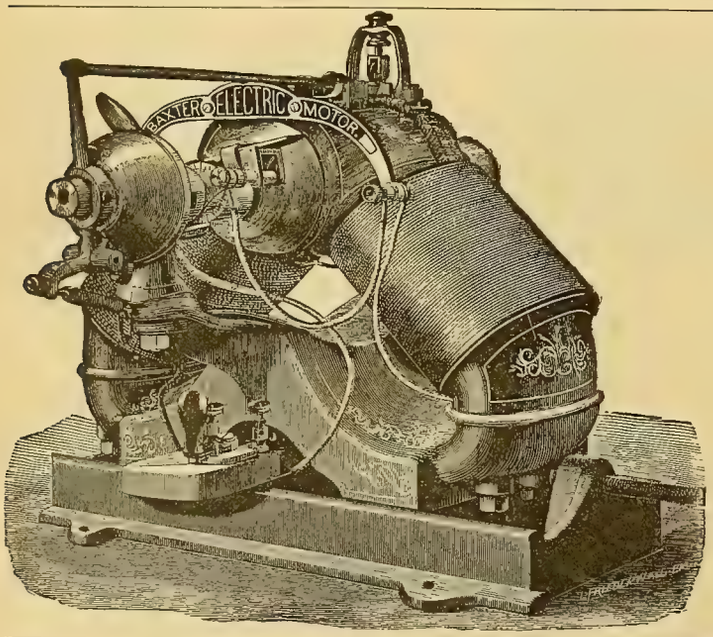

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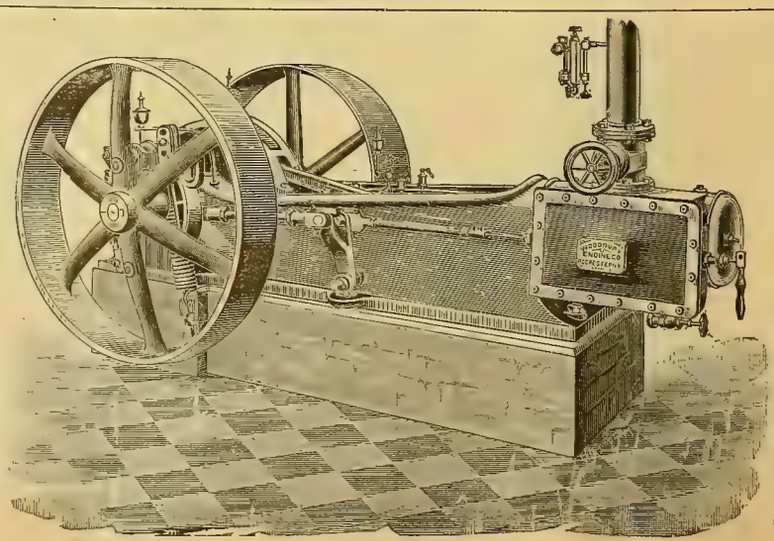

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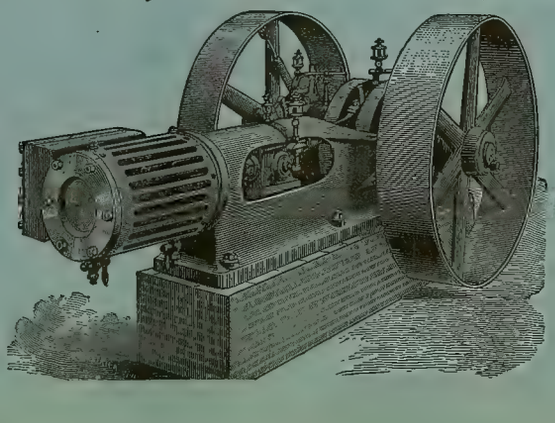

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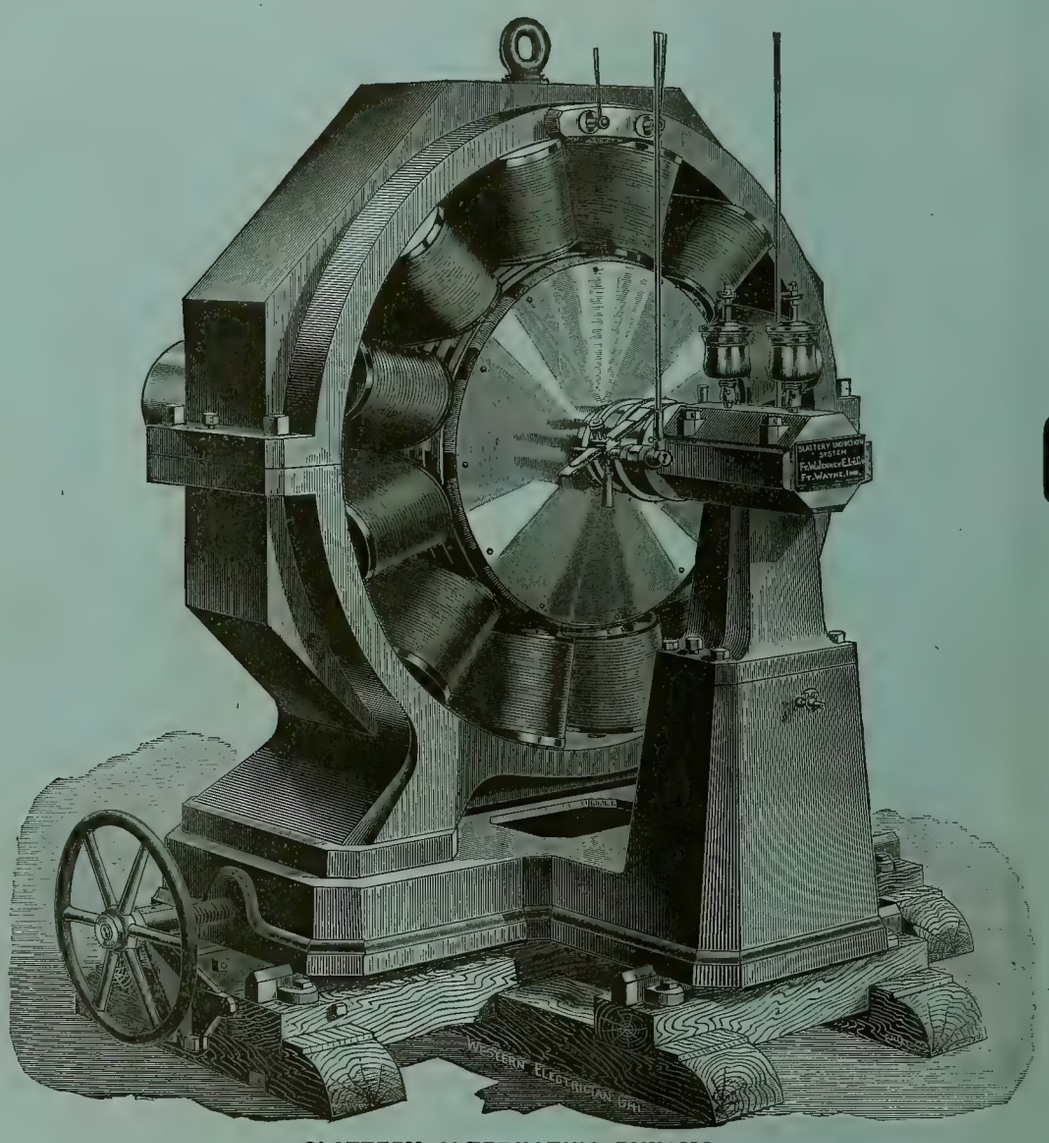

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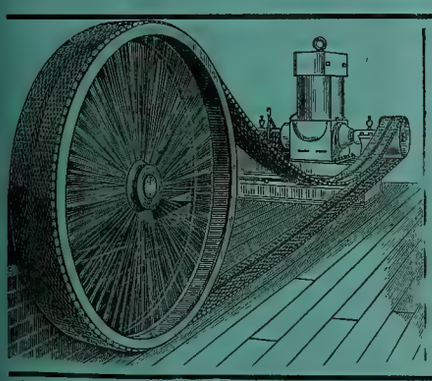

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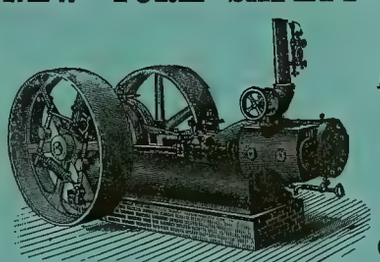

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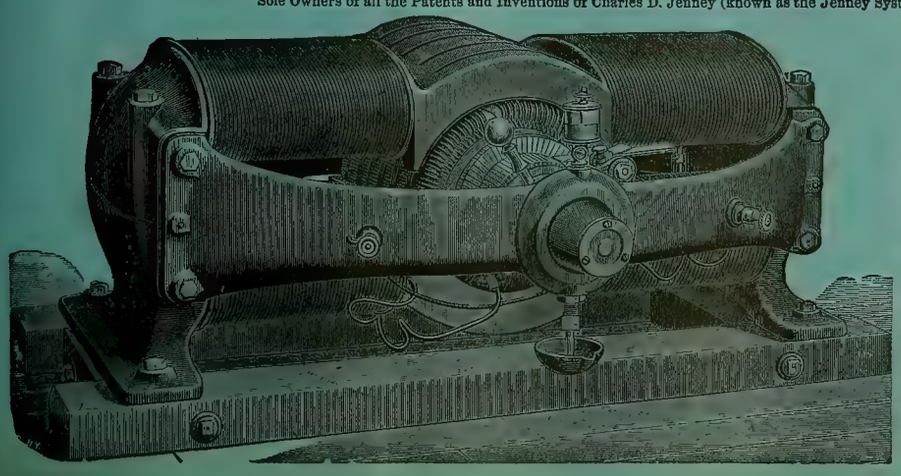

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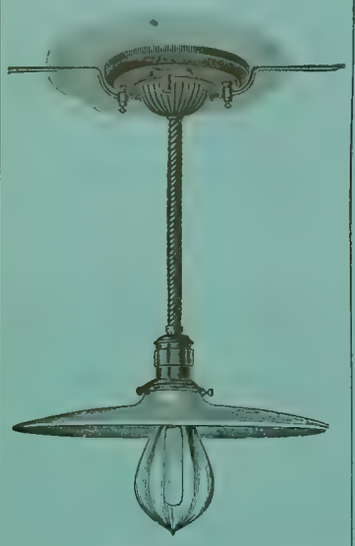

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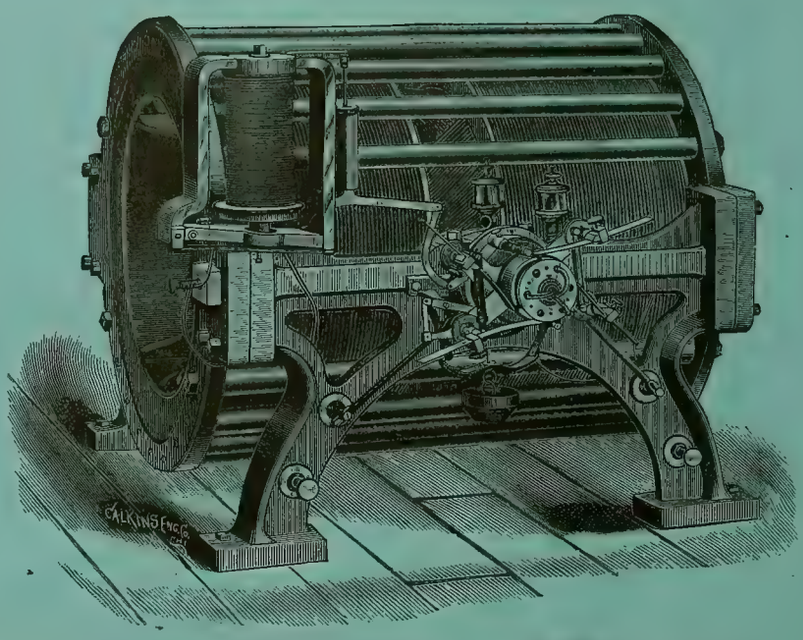

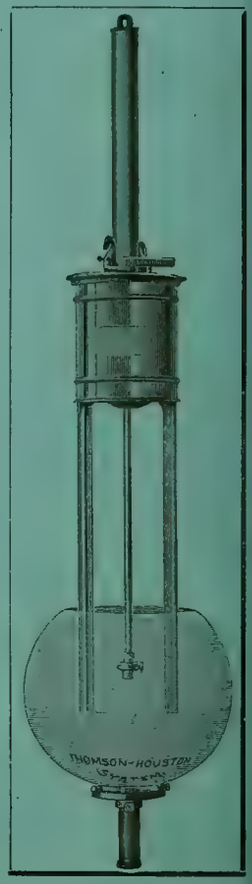

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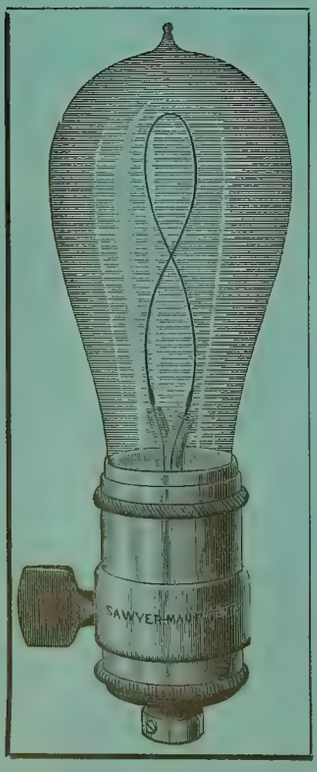

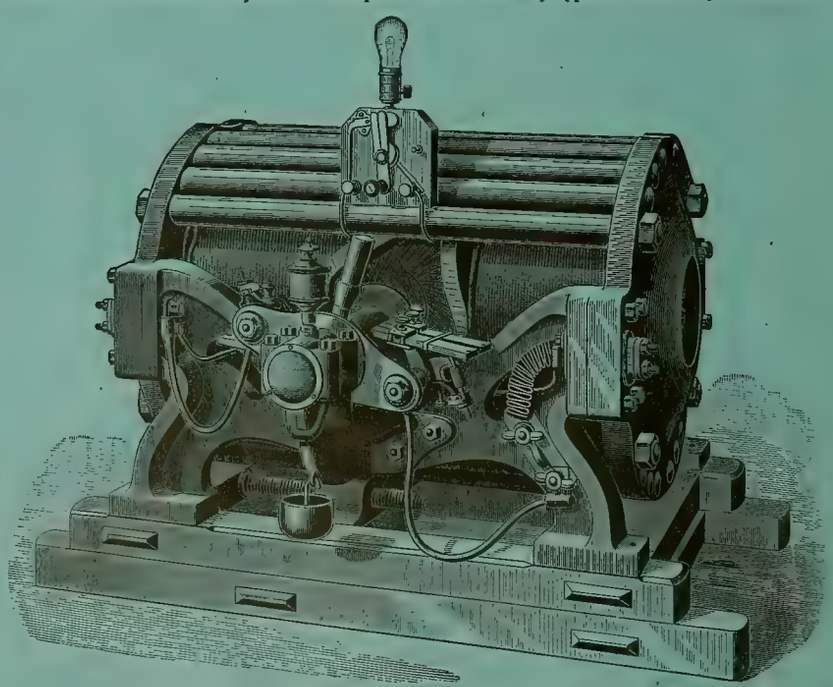

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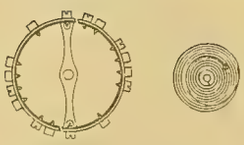

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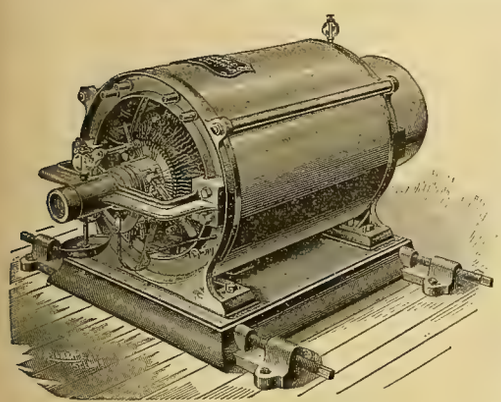

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We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

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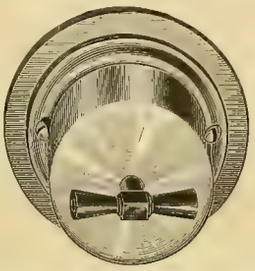

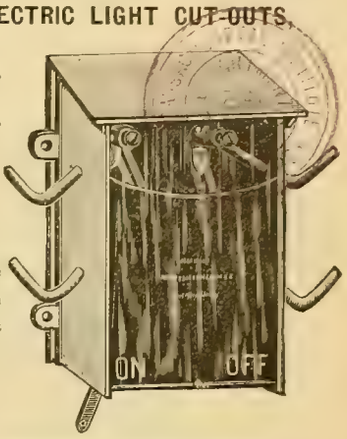

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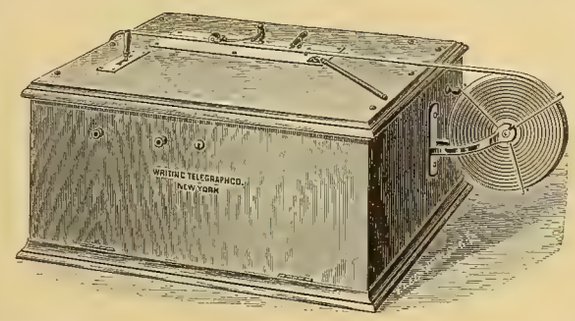

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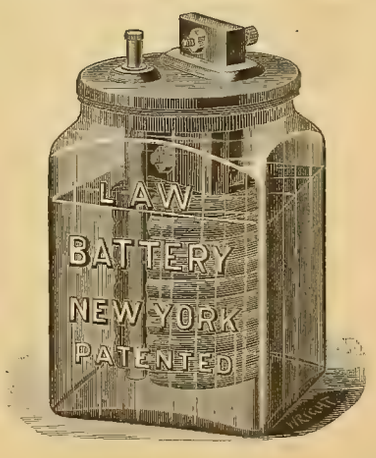

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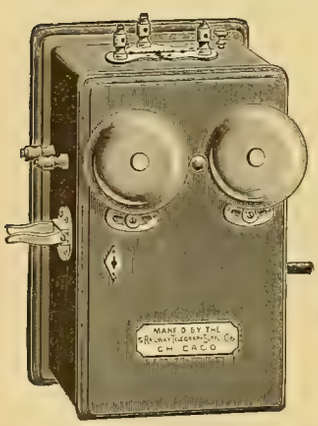

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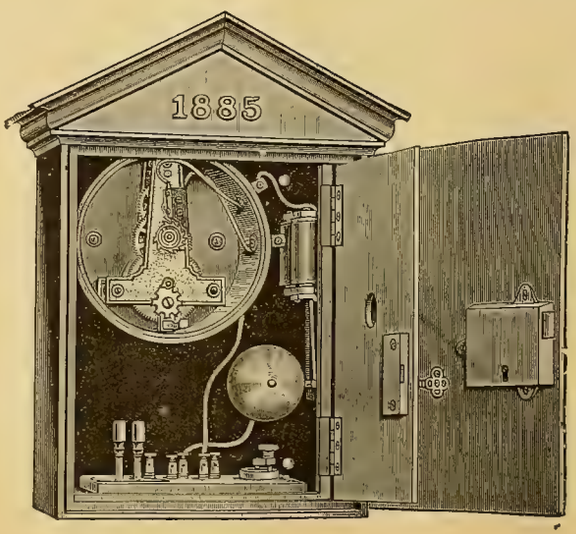

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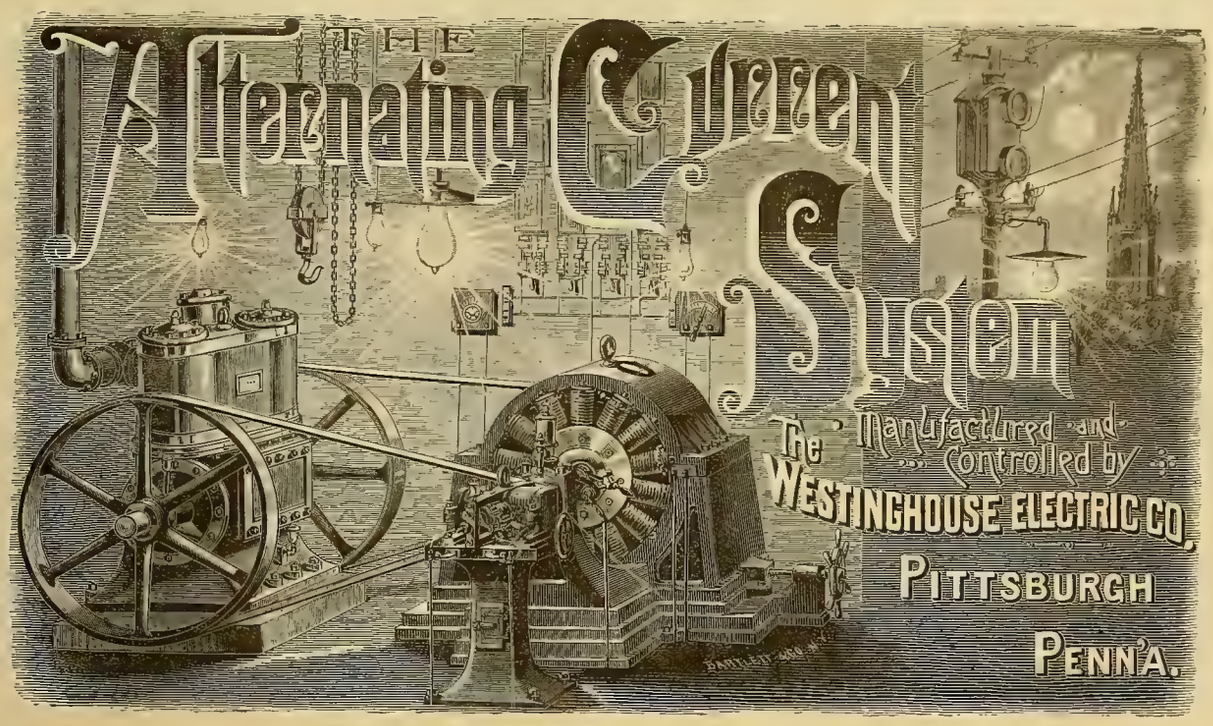

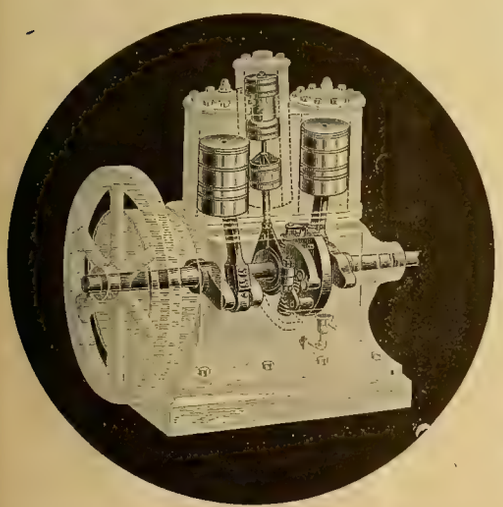

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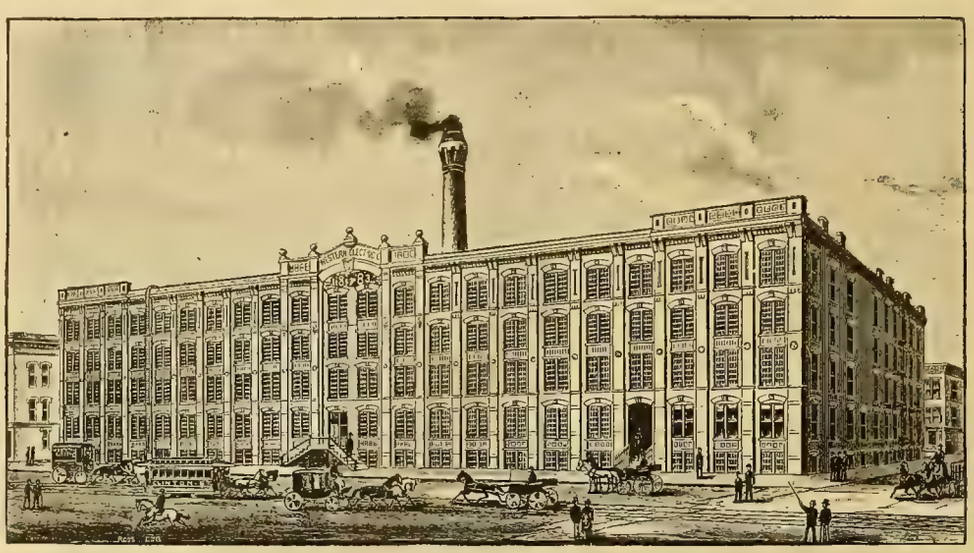


CHICAGO FACTORY.

Disque LeClanche Battery.

Western Electric Co., Chicago, Ill., April 10, 1888.
Chicago, Ill.

Gentlemen: Replying to your inquiry of this date, I would say, I have kept a record of the service we get from many of the Disque LeClanche porous cups furnished the Chicago Telephone Company by you since September, 1884. Without going into the minutiæ of this record I will state that it shows that we have had batteries in use which have been in CONSTANT SERVICE for about THREE YEARS and EIGHT MONTHS, and that the AVERAGE SERVICE which we get from porous cups of your manufacture is OVER ONE YEAR and SIX MONTHS.

Our inspectors are instructed to replace porous cups as soon as they show signs of failure, and many of the porous cups brought in as having been used up are still in fairly good condition and would give good service in places which do not require the work from a battery which telephone service requires.

Yours very truly,

J. J. NATE,

Purchasing Agent Chicago Telephone Co.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, APRIL 28, 1888. No. 17.

Voltmeter of The Slattery Induction System.

The engraving shown on this page represents the voltmeter of the Slattery induction system, controlled by the Fort Wayne Jenney Electric Light company, Fort Wayne, Ind. This illustration forms a complement to those published in No. 7, Vol. II, of the WESTERN ELECTRICIAN and a description of the instrument will be found in the same issue.

The Comparative Value of the Alternating Transformer and Continuous Current Systems for Central Station Lighting.[1]

BY F. B. BADT.

Gentlemen:— We have heard three papers on apparently the same subject, though each of these papers was named differently by its author. I know a good many of you are under the impression that I will be an advocate of the alternating system, against the continuous current system; but such is not the case. In the title I have given my paper, I have narrowed this discussion to its proper limits. I do not believe, by any means, that the alternating transformer system will be substituted for isolated lighting, or for lighting within moderate distances, but I do believe that for an economical central station lighting system, the alternating transformer system is the best in existence. This remark may seem superfluous, but lighting within short distances, and even isolated lighting, has been been dragged into the discussion on this subject. Although the author of the first paper read apparently tried to show that the only practical system for central station lighting of to-day, is the 3-wire system of, say, not exceeding 230 volts, I propose to show to you that this attempt is not even consistent with the practice of the company this gentleman represents. In the first place, let me read an abstract of a circular concerning the Edison municipal system.

I quote: "The Edison municipal system has especially been devised to meet all the requirements of perfect outdoor illumination. * * * The current used in this system is of high tension (1,200 volts) which would be unsafe to introduce into dwellings, hotels, stores or buildings of any character, where the wires and sockets are liable to be handled by inexperienced persons, but when they are stretched on poles in the open air, and the lamps are attended by persons who have been properly trained, all danger to the public ceases. If desired, the circuits for this system can be laid underground at at reasonable cost.

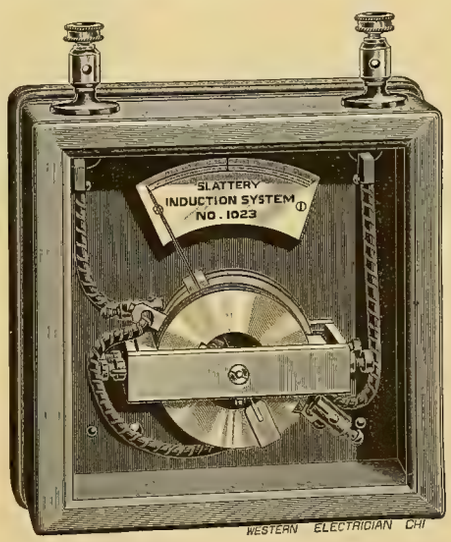
"Each lamp is screwed into a socket which is protected from rain by a metal hood, and in the upper part of the hood is placed an apparatus that closes the circuit whenever a lamp carbon breaks, thus keeping the continuity of circuit uninterrupted. At the same time an instrument in the station indicates the breakage, so that the attendant may be sent out with another lamp to replace the broken one."

N. B. I hope he is provided with a bicycle.

Secondly, I will quote from a paper read by a gentleman during the Edison convention in Chicago, February, 1888:

"A modification of the Edison 3-wire system was mentioned where two Edison 600 volt, 26 ampere dynamos furnished current for several hundred lights; five 110 volt lamps being used in series on either side. The dynamos run without sparking, there is no more evidence of high pressure visible at this plant, or in the municipal 1,200 volt machines, than with 125 volt dynamos. There is probably no more perfect plant running than this, which has been in service since the middle of last year." And, again, "Within proper limits, the principle of high pressure is not absurd or inconsistent with correct principles of future progress. The idea underlying the transformer is the logical outcome of experience, but thus far we have no satisfactory application to general commercial uses, excepting, possibly through the electric motor."

Now, gentlemen, in both cases an electromotive, force of 1,200 volts is employed and they call the last named system a "modification of the Edison 3-wire system." If what we heard in the first paper is true, why does the same company employ an electromotive force up to 1,200 volts? The 1,200 volt 3-wire system, as I understand it, is used for store lighting, and is introduced into houses; while in the pamphlet concerning the municipal system, the introduction of 1,200 volts into houses is condemned.



Where is logic? Where is consistency? I can not see it, but I hope that during the discussion which probably will follow the reading of this paper, some of the gentlemen will be kind enough to explain it to me. I am well satisfied that there is a tendency, even among the most ardent advocates and admirers of the low tension system for central station plants, to occasionally raise the electromotive force when they can not raise the necessary money to buy copper enough for their feeders and mains on the 230 volt 3-wire plan. There is certainly less objection to even a 1,000 volt alternating transformer system than to the introduction of a 1,200 volt continuous current into houses.

Now, gentlemen, what I believe is that all these systems, namely: Multiple arc, 3 wire and multiple series *continuous* current, as well as multiple arc, multiple series and transformer *alternating* system, are good in themselves, and that it is our task to find the proper places and the proper conditions for each. Each one has its place. We all agree that for isolated lighting, the multiple arc system is the best; whether continuous or alternating is a question which I do not want to answer here. For longer distances we will properly use according to circumstances, multiple series of 2 lamps (3-wire) or multiple series of more lamps, again either continuous or alternating. And for still longer distances, we will employ a general system of incandescent lighting, where all points near and far must be reached in order to supply *all* customers, the *alternating transformer* system. These few remarks will probably outline my ideas of the application of the different systems of incandescent lighting under different conditions. What I want to show, however to-night, is the comparative value of the alternating transformer system and the continuous 3 wire system for central station lighting. I will adhere to the points named in the previous papers, namely:

First—First cost.

Secondly—Economy, efficiency and depreciation.

Thirdly—Reliability.

Fourthly—Variety and value of the possible sources of revenue.

Fifthly—Safety to life.

Sixthly—Effects upon existing property.

First and Secondly.—First cost and economy. (*Efficiency and depreciation.*)

It was shown in the first paper that the cost of the conductors transmitting a given amount of energy at given loss for a given distance varies inversely as the square of the initial electromotive force employed. Figs. 1 to 6, show the combined cross section of copper feeders at 5 per cent. loss for 500 16 candle power 110 volt lamps at a distance of one mile. They represent:

Fig. 1, Multiple arc. (110 volts.)

Fig. 2, 3-wire system, according to Professor Forbes (220 volts).

Fig. 3, 3 wire system, according to H. Ward Leonard, (220 volts).

Fig. 4, Five 110 volt lamps in series (550 volts).

Fig. 5, Alternating transformer system (1,000 volts).

Fig. 6, Alternating transformer system (2,000 volts).

The ratio is as follows:

TABLE NO. 1.

FIG.	1	2	3	4	5	6
System	Multiple Arc	3-wire Forbes	3-wire H. W. Leonard	Multiple Series	Alternating Transformer	
E. M. F.	110	220	220	550	1,000	2,000
Ratio of Cost of Feeders	328	246	108	13	4	1
Cost of Feeders per lamp at 5% loss at one mile	$71.00	$53.00	$23.00	$2.80	$0 85	$0.21

I think this table is perfectly clear without any further explanations. I will repeat, however, the statement made by Mr. Slattery, that according to Professor Forbes (as shown in his paper published in the New York *Electrical Engineer*, July, 1885), the saving of the 3 wire over the multiple arc system is only 25 per cent., and that to assume any more saving may suit American financiers, but is not electrical engineering. The originator of the so-called Edison 3-wire system, Dr. Hopkinson, of England, thoroughly coincided with Professor Forbes in this view.

For the sake of argument, however, I will assume whenever I speak of the 3 wire system, the figures given by Mr. Leonard, or a saving of 66⅔ per cent. over the multiple arc system.

Table No. 1 also shows the cost of feeders per lamp, at 5 per cent. loss, at one mile, assuming the cost of copper at 20 cents per pound. In

[1] Read before the Chicago Electric club, at a special meeting, April 23, 1888.
The fourth of a series of papers upon the subject, "The Continuous Current vs. the Alternating Current," before the club.

Mr. Leonard's paper the parallel was drawn only between the thousand volt alternating system employing 50 volt lamps and the 3-wire system employing 110 volt lamps. I hardly think this fair, as it increases the cost of copper wires for the secondary circuits four times the cost of the copper wires in the branches of the 3-wire system. In making this comparison the most economical alternating systems employed to-day in Europe and America should be considered. These systems employ an electromotive force in their primary mains of about 2,000 volts and use 110 volt lamps in their secondary circuits. Any improvement which in future should be made in these lamps, will, of course, be an improvement in the alternating transformer system as well as in the 3-wire system.

Now, in comparing the cost of the two systems, I will, for the sake of argument, again compare the 3-wire system to the one thousand volt alternating system. Let us assume that the cost of feeders per lamp at a certain distance for a 1,000 volt alternating system at 2½ per cent. the loss is one dollar. Then, according to Mr. Leonard, the cost of the copper for the 3-wire system would be $27.50. Table No. 2 gives the cost of the two systems at 2½ per cent., at 5 per cent., at 10 per cent. and at 20 per cent. loss.

Table No. 2.

Comparative Cost of Feeders per Lamp.

Loss in Feeders.	3-wire System.	1,000 volts Alternating System.	Difference of cost between the two systems.
2½%	$27.50	$1.00	$26.50
5 %	13.75	.50	13.25
10 %	6.87	.25	6 62
20 %	3.43	.12½	3.30

You can very easily see that the ratio in columns 2 and 3 is the same, but I want to draw your attention to column 4, showing the difference of cost per lamp in the two different systems under the conditions named. Suppose now that the cost of machinery, including boilers, pumps, engines, dynamos, house wiring and lamps in each case is about $15,000 for a 1,000 light plant. We would have to add in the 3-wire system, figuring on 20 per cent. loss with full load:

1,000 × $3.43 = $3,430.

In the alternating system we would have to add,

1,000 × $.12½ = $125.

But we will allow five times this amount in order to enable us to get a wire of very high insulation. This would make $625. In addition we should calculate $3,000 for transformers, ($3 per lamp). This would make a total of $3,625.

It must be borne in mind however, that a pole line, or underground conductors for the 3-wire system would be much more expensive than for the alternating system for obvious reasons. This would give us the following total result:

Total cost of 1,000 light 3-wire system, $18,430.

Total cost of 1,000 light transformer system, $18,625.

This would show the 3-wire plant $195 cheaper than the alternating plant.

But now let us make some calculations on 2½ per cent. loss in the feeders; and we find that the feeders for the 3-wire system would cost

1,000 × $27.50 = $27,500.

and for the transformer plant,

$5,000 (again allowing five times the cost of copper for good insulation) and $3,000 for transformers, making,

Total cost of 1,000 light 3-wire system, $42,500.

Total cost of 1,000 light transformer system, $23,000.

This would make the transformer system $19,500 cheaper than the 3-wire system.

You can very easily see the trick in this calculation. Take a certain amount of money as cost for the entire plant, excluding copper feeders, in both systems and also excluding transformers in the alternating system; and assume a comparatively high loss in feeders; the difference in cost for such feeders in the two systems will then appear as a small percentage of the total cost of the plant. Then assume a high efficiency of such conductors, say, only 2½ per cent. loss, and the cost of such feeders will be a very large per centage of the total cost of the plant. You see in column 4 of table number 2 that though the ratio at different losses is the same, the difference in cost will appear very small when a large loss in the feeders is allowed.

This method of calculation is not electrical engineering, but is instead a calculation invented and probably patented by some selling agent, who worked on commission. You can very easily see that if you want to sell a low voltage system, a high loss must be assumed, but if you want to sell a high tension transformer system, a small loss in feeders is permissible and competitive with the low voltage copper mine system. Thus you can make the total cost of the low voltage plant appear smaller or greater than the total cost of the alternating plant, as occasion may require. I very reluctantly make public this trick of the trade, but there is no charge for it to those gentlemen who should not have known it.

Now the question, of course, could be raised, why not figure on a higher percentage of loss in the feeders and still get the good results as shown in the first paper. I simply say this: Assuming a high loss in copper feeders is poor electrical engineering; it is a permanent waste of power; it requires complicated apparatus and permanent attention to keep the pressure alike in the different feeders with varying loads; it will cause greater lamp breakage, as necessarily even in the best laid out system, the potential will very often rise in some of the branches far above the normal; it necessarily must be quite a complicated task of electrical engineering to get all the conditions right for best results. On the other hand, with a small loss and a nearly constant pressure kept at the main distributing point, all these difficulties disappear. The electrical engineering part becomes very simple and lamps can be attached almost anywhere to the line without throwing the system out of balance. Simply the impossibility of advocates of the low tension 3-wire system inducing capitalists to spend money enough for such large conductors, as a small loss in the feeders would require, prohibits them from acknowledging all these advantages; and they necessarily must claim that it is good economy to lose more energy in the wires.

You can very easily see that the average load and loss question in table number 1 of the first paper was simply introduced in order to make the loss appear smaller than it really is. Now I think I can save a good many arguments by simply referring you to the picture which you behold here. It represents a low tension 3-wire system in Minnesota. The first pole near the station, carries all the outgoing wires; there are

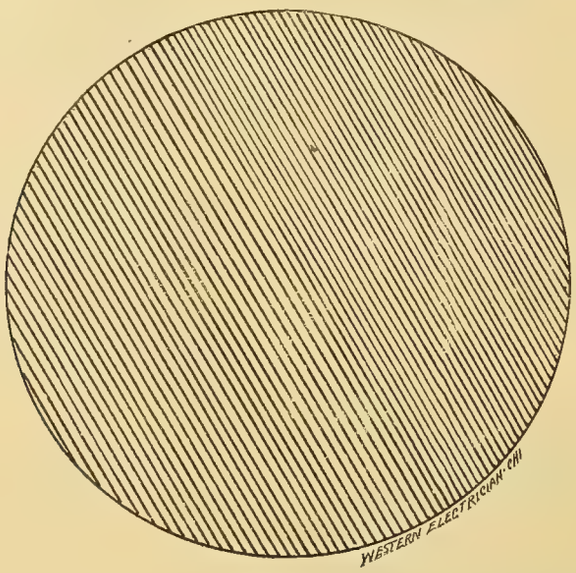


FIG. 1

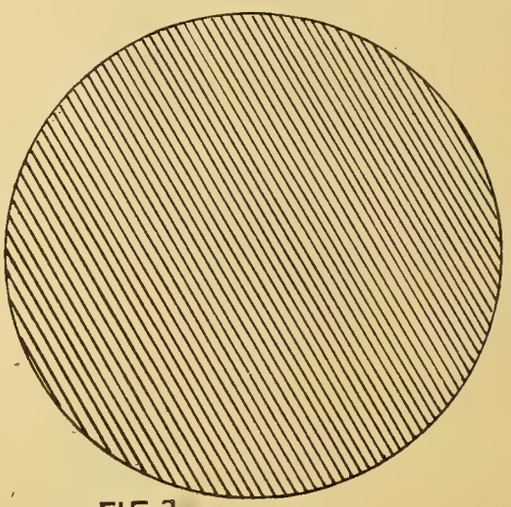


FIG. 2

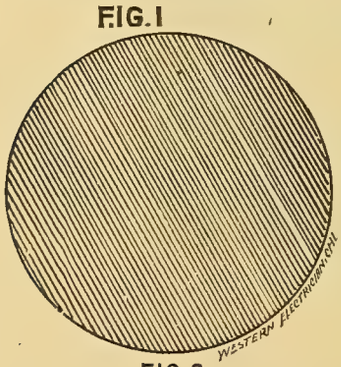
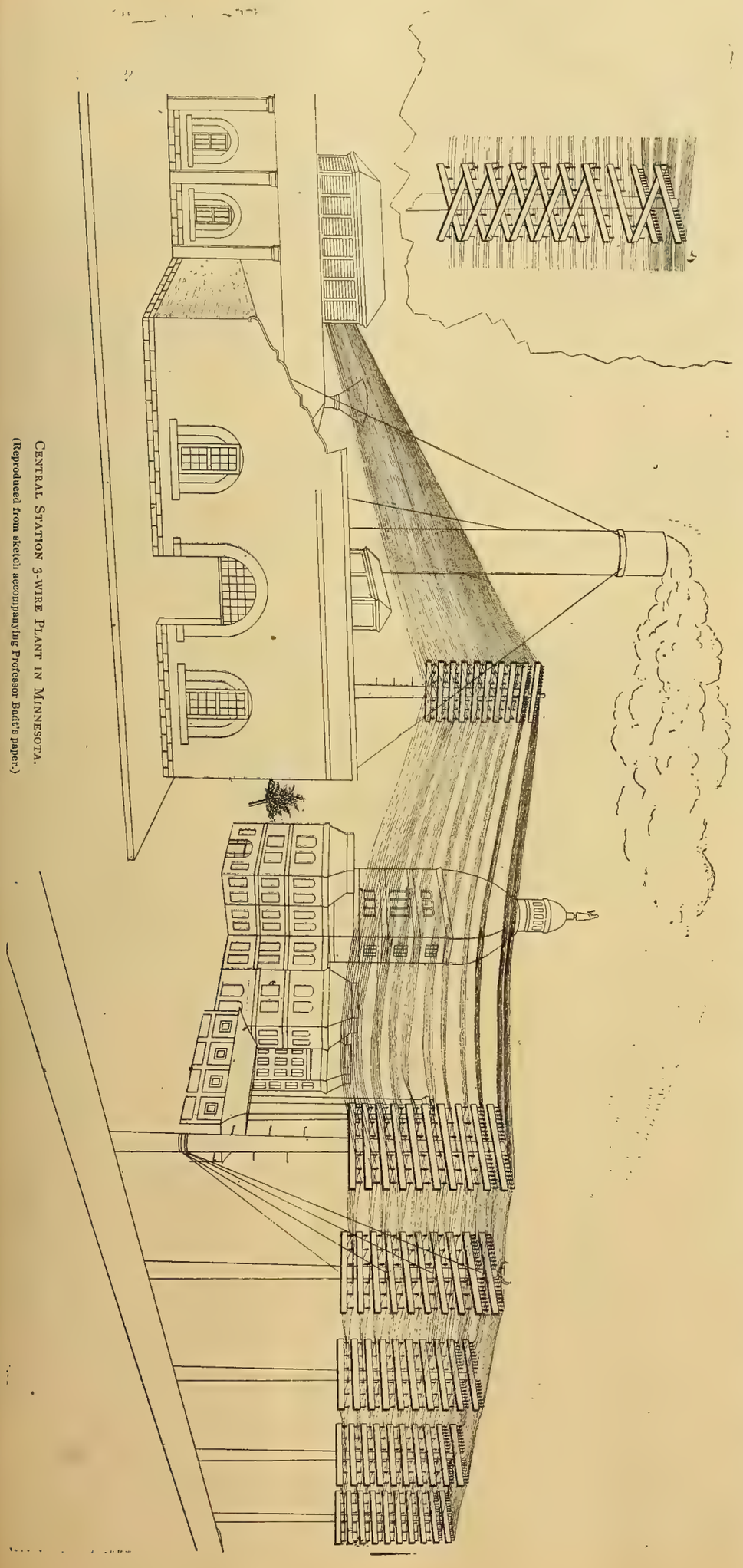


FIG. 3

FIG 4

FIG. 5

FIG. 6



CENTRAL STATION 3-WIRE PLANT IN MINNESOTA.
(Reproduced from sketch accompanying Professor Budt's paper.)

54, varying in size from No. 0000 wire to No. 6. About one half of the wires are No. 0000 and the remainder in varying sizes from 0 to 6. Don't forget to scrutinize this corner pole. Lamps of various candle power are put up, whose equivalent amounts to about 7,500 10 candle power lamps. The average number of lamps burning during the day amounts to 2,000, while the average number in use during lighting hours is about 7,200. The loss in these feeders amounts with full load, to about 20 per cent; in one circuit it is even more. The claims as far as economy is concerned, are ten 10 candle power lamps per horse power, including the loss in the conductors. The station is equipped with 10 dynamos, 5 engines and boilers for about 1,000 horse power. There are 14 employes connected with the station. The coal consumption for 24 hours, is about 53,000 pounds.

Now gentlemen, taking these data, and the picture before you, do you think that the theoretical tables and curves we had explained in the first paper were known to the gentlemen who laid out this station? The fact of the matter is that such a station as is illustrated, can neither be economical nor on a paying basis. It can be only the laughing stock of electrical engineers except those who own some stock in the concern.

A 2,000 volt alternating system would, of course, show up far better than a 1,000 volt system, as far as first cost and economy is concerned. Even granting that the efficiency of an alternating dynamo is not quite as good as that of the continuous current dynamo, and that a small percentage of loss will occur in the transformers, what are these in comparison with the enormous loss in the feeders of a 3-wire system, and the necessity of all the complicating balancing devices at the station necessary in that system?

There is one point, however, which has not been touched upon, and that is that the whole calculation made in the first paper, was based upon the fact that the number of lamps fed by different feeders was at all times reduced in the same proportion. I know from practical experience that in most plants, this is hardly ever the case, and that resistance must be introduced to equalize the varying losses in the different feeders. This not only means waste of power continuously, but it also means wages of employes to watch the necessary instruments continuously, and to keep the different feeders balanced. So much for economy and efficiency. Of course, I do not want to repeat all the points covered in the paper read by Mr. Slattery nor by the latest communications to the electrical journals made by advocates of the alternating system against the 3-wire system as expounded by Mr. Leonard.

As far as depreciation is concerned, let me again draw your attention to the beautiful picture of the Minnesota 3-wire station made by our special artist, and let me simply ask the question, would you rather repair transformers, or would you prefer to keep a pole line covered with a network of naked wires in repair? Suppose customers did not renew their contracts for lighting; which would be cheaper, to take a transformer and place it somewhere else, or have a high priced electrical engineer sit down and calculate how to balance that line again and take a couple of hundred lights from one place and transfer them to another point on the circuit. These points I think naturally apply to the chapter headed "depreciation."

I grant that well insulated wire will depreciate more rapidly than bare copper wire, but for my part I would prefer to keep 6 well insulated wires in repair, than a pole line with 54 naked wires as here illustrated.

Whether the depreciation of a high tension dynamo is greater than that of a low tension dynamo, is a question that can only be answered after more experience than we have had up to this time.

Thirdly, Reliability.—I can see scarcely anything in the corresponding chapter of the first paper which still needs answering. I certainly can not see that for the reasons given, a continuous current system is any more reliable than a transformer system. Again let me draw your attention to the picture. I think that in the network of wires represented, troubles are more likely to occur than in 6 well insulated wires. Practical experience so far has not shown that

the alternating transformer system is not as reliable in operation as the low tension continuous current system.

That a switch-board in an alternating central station plant should be more expensive than a switch-board and the necessary apparatus to run a 3-wire plant, is something very surprising to me. I think that from what I have seen of the two systems, that the traps used in a 3-wire station plant cost at least five times as much as those used in an alternating plant. What our contemporaries in Europe think of the reliability of the two systems, will best be illustrated by the following examples :

First—Milan, Italy, had a low tension direct current 10,000 light station. To reach a theater 6,500 feet off, they added a Zipernowski-Deri 1,800 volt alternating transformer system, using underground cables.

Second—Dijon, France. This town had a low tension direct current central station, located in the center of the town. The city council regarded the noise of steam engines, smoke, etc., in the heart of the city, a public nuisance, and compelled the local company to go to the outskirts. The company abandoned the whole continuous system and replaced it by a Zipernowski-Deri 1,800 volt alternating transformer system.

Third—Rome, Italy. A large central station is being erected and is partly finished—all done on the Zipernowski-Deri 1,800 volt alternating transformer plan, with a capacity of about 18,000 lights at distances of 10,000 to 16,000 feet.

Where, gentlemen, is the low tension plant reaching customers at such distances ? I could go on in this way *ad infinitum*, but I think these few examples will suffice.

Fourthly, Variety and value of the possible sources of revenue.— The question of increasing the income from the central station by renting out power has been ventilated before and it has been shown that it is not by any means impossible to run motors on the alternating transformer system. It has been found furthermore that in practice it is advisable to run a separate circuit for the distribution of power. There is no objection to using continuous current dynamos for this purpose. It could be said that extra dynamo capacity would be necessary in such cases but I hardly think this is true. It certainly can not be expected that the same dynamo will run day and night in succession without ever stopping. I think that a certain reserve is necessary in any event. In the central stations I have seen only a part of the dynamo capacity is used during the day and the whole during the main lighting hours in the evening, leaving no reserve whatever. If these same dynamos should be loaded, running motors all day, there would be in my opinion a continuous strain put on the apparatus which is certainly not advisable.

I quote from the first paper the following: "Then there is an almost unlimited number of applications of a continuous current on a small scale for such purposes as fire alarms, burglar alarms, distribution of time, annunciators, tickers, electro-plating, telegraph lines and telephones, all of which rely upon a continuous current."

Now I would like to have somebody tell me from what central stations such applications have been made on a large scale and on a paying basis. I do not know of any and I think no central station would like to be troubled with these infernal little nuisances. The amount of money which could be gotten as revenue for furnishing current to these appliances would certainly not compensate for the trouble they would continually cause. Therefore I must say that I can not see that the alternating system is any more dependent for its revenue upon the sale of light alone than a continuous current system.

Fifthly, Safety to Life.—The danger to human life from high tension alternating currents is always held up as a bugbear by the advocates of the low tension continuous system. In the first paper it was stated that it has been conclusively proven in practice that a 1,000 volt alternating current is fatal to human life and will kill a horse. I do not know of any experiments made in that direction, but it would certainly be interesting to know how much larger an animal than a horse could be killed by a 2,000 volt alternating current. A telephone operator at Pittsburgh, who was killed dead by the first paper with a high tension current, while handling the switch board at the telephone exchange, has come to life again in a communication to the WESTERN ELECTRICIAN. Maybe the same will happen yet with the horse. The fact of the matter is that at least ninety cases out of a hundred where persons have been killed by the high tension current death has been caused by the extra current set up in the field of a series dynamo when the external circuit was broken by the victim. Now, gentlemen, this danger does not exist in any alternating system.

The field of the alternating dynamo is separately excited and such a powerful extra current cannot be set up and discharged through the body of the careless workman even in case he should break the external circuit. I therefore claim that the main cause for *fatal* accident does not exist in the alternating high tension system. There is another danger which I think is greater in the continuous current system than in the alternating high tension system. Just look at that picture hanging before you again and imagine a workman in that net work of wires short-circuiting two of those heavy copper conductors by some means. The result would be a pound or so of molten and fused metal which would not only inflict very severe wounds but might even prove fatal. Quite a number of cases have come to my knowledge where persons have lost their eye-sight or got otherwise mutilated by such accidents. You must remember that the wires of a low tension system are mostly bare while the wires of the high tension alternating system are well insulated. It may be asked why, in the case mentioned, the safety strips would not prevent such an accident.

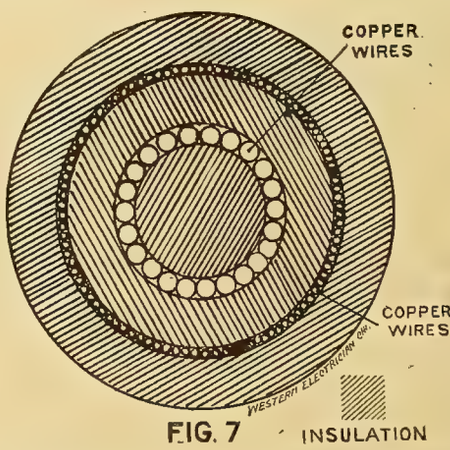


FIG. 7

I will say that heavy fusible plugs melt rather slowly and would not break the circuit in time to prevent the accident. The smaller safety strips of the high tension alternating system carrying only a few amperes would respond a good deal quicker though, as mentioned before, such an accident is less liable to happen in this system.

Sixthly, Effect upon existing property.—Why a low tension continuous system should be better protected by safety strips than a high tension alternating system is a conundrum to me and I refer to the discussion of this matter following the reading of Mr. Warner's paper. The inductive influence which might cause trouble to telegraph and telephone lines can be just as easily avoided in a transformer as in a low tension direct current system. For underground work, I think a cable, as represented in Fig. 7, would prevent all such troubles and would furthermore prevent the retardation of the alternating system as explained in a brief article of mine published in the *Electrical Review*, Sept. 3, 1887. It may be mentioned here that wires carrying an alternating current are not in danger, from electrolysis, and that the wires keep cleaner if fastened underneath ceilings or on walls. Wires carrying continuous currents will very soon show a layer of dust and dirt which will appear as a demonstration of the magnetic whirls surrounding the wires.

In conclusion, I will give a *resume* of the advantages of the alternating transformer system, as used for station lighting, in comparison with the 3-wire system of distribution.

ADVANTAGES.

1. Location of central station plant need not be in the expensive center of the city, but cheap real estate and power miles off can be utilized, thus decreasing the cost materially.

2. All customers near and far may be reached on a paying basis.

3. The price of conductors for feeders and mains is reduced to a minimum.

4. These wires being very small, the cost for poles and erecting lines or of underground work is materially reduced.

5. It does not take any great electrical engineering skill or complicated calculations to lay out such a system and make any alterations which may be necessary in the course of time.

6. The system is very simple, requires comparatively few stationary appliances and fewer employes for regular running and repairs.

7. The small loss in the feeders will result in greater efficiency, more lamps to the horse power, smaller engines will be employed, less fuel consumed, and the earning capacity of the whole plant will be greatly increased.

8. It is be easier to keep the electrical pressure constant thus burning the lamps at all times at even candle power and lengthening their average life.

President Stiles occupied the chair at the meeting of the Chicago Electric club, Monday evening last. No business was transacted. At the close of the reading of Professor Badt's paper, Mr. Bliss moved that a vote of thanks be tendered the professor for his very able paper. The motion was carried unanimously.

THE PRESIDENT : I suppose that there are some members present who would like to make some remarks upon this paper. I rather think that Prof. Badt expects it from the way he delivered the address. We would be very glad to hear from anyone. Mr. Warner, I think, may have something to say, and I would like to hear from him in regard to it.

MR. WARNER : Prof. Badt's paper strikes me as having covered the ground very fully, and as having answered a number of the questions that have been brought up in regard to the relative merits of the two systems very fairly. At the same time I think that there are a number of very important points that remain, as it were, uncovered, that will still demand a closer examination and discussion. The question seems to narrow to about this : Whether, if we are doing central station lighting, it shall all be done with one system, or we shall combine or mix the systems. It seems to be pretty generally conceded by those who have taken part in the discussion thus far, that for lighting within a certain radius the Edison three-wire system, or a system of that description, would be the most economical ; that beyond that distance a converter system of moderate potential, such as 1,000 volts would fill the bill ; getting outside of that, one of two thousand volts. Now, while that has been touched upon in all these papers, it strikes me that it has not been as fully brought out and as clearly shown as it might have been. I would like to hear an expression of opinion from Prof. Badt in regard to that very point.

PROF. BADT : Mr. Chairman, I think we touched upon that very idea. In fact, the first diagram which you see there refers to the value of the different systems at different distances. If all conditions were alike in all cases it could be very easily calculated which system would be most economical. It could be found, for instance, that up to a thousand feet, a multiple arc ; 3,000 feet, 3-wire, and so on, but as the conditions vary it cannot be calculated even approximately. I most heartily endorse Mr. Warner's idea that under certain conditions it will be most economical and most practical to light the district nearest to the central station by means of a low tension system, and the further you go, the higher the tension should be employed through the system. I believe that in cases where the station and the power can be located in or near the center of the city, all the business blocks should be lighted with a low tension system, and then for the outskirts, for street lighting, to reach places and theaters far off, an alternating or any other high tension system which will answer just as well as a high tension alternating system should be employed.

MR. BLISS : I would like to ask which size wire shown by the diagrams you would use for a mile distance —which you would consider it advisable and practical to use for an alternating system say of a thousand or two thousand volts ? What, practically for strength, for reliability and durability in construction, you would consider it advisable to use. I do not know what these sizes are. That two thousand volt wire there (referring to diagram) seems to be a pretty small thing for strength.

PROF. BADT: I would say in answer to that, that a two-thousand volt alternating current would require for 500 lights at a mile distance about a number 4 Brown & Sharpe wire. That wire would be strong enough to stand any amount of strain and would only allow for two and a half per cent. loss.

MR. BLISS: I would like to ask Prof. Badt another question: Is it a fact that there are any motors at present being used on alternating systems? Are they in practical use at present on alternating systems?

PROF. BADT: I will say in reply to that, Mr. Chairman, that I cannot tell. I have not seen any, and I do not know whether there are any in use. But this statement of mine was simply made as an answer to the statement of Mr. Leonard. He said that very soon we would see a continuous current converter. Now, these things are so far unknown to us, and I do not think it is right to drag them into the discussion at all because—well, I will quote

(*Continued on page* 211.)

A New Induction Coil.

Inductional transformers or converters are now receiving such widespread attention in electrical circles, in connection with the distribution of electricity by means of high tension alternating currents that any really new departure in the construction and general design of such apparatus cannot fail to be of very considerable interest and importance.

Illustrations are shown in connection of an induction coil forming the subject of United States Letters Patent Number 380,138, granted to Elias E. Ries of Baltimore, Md., March 27, 1888, that appears to possess several novel and meritorious features. In this apparatus the high tension primary wire is completely inclosed within and protected by the low tension secondary, the two forming a single compound conductor. By virtue of this ingenious and simple arrangement, a number of important results are obtained both in the construction and operation of the apparatus, some of which are of considerable value from a practical as well as a theoretical standpoint.

In the accompanying cuts, Fig. 1, shows a compact and simple form of cylindrical transformer wound with the compound conductor; Fig. 2, an enlarged sectional view showing the method of connecting the end turns of successive layers of the compound winding to permit of grouping the low tension, or secondary conductor into one or more parallel sets; Fig. 3, an elevation and section of the combined primary and secondary conductor.

The inductional conductor shown in Fig. 3 is applicable to the ordinary form of induction coils, such as those of the Ruhmkorff type, but it is intended more especially for use in connection with the modern transformers for converting high tension line currents into low tension working

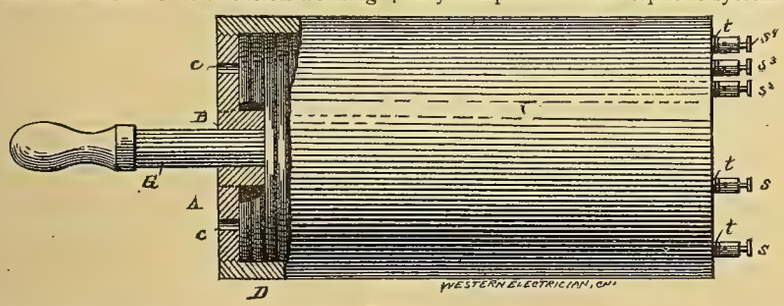


Fig. 1.

currents. In either case the central conductor carries the high tension current. This arrangement insures not only absolute safety by reason of the protected and thoroughly insulated condition of the high tension conductor, but also a high degree of efficiency in conversion, due to the absolute parallelism and close relationship of the primary and secondary windings, throughout their entire length. Moreover, as each unit length of secondary wire completely surrounds a corresponding unit length of primary or inducing wire, the available output of the induction apparatus due to the action of the primary impulses upon the magnetic core is re-inforced and considerably augmented by the *direct* induction that takes place in this apparatus between the primary and secondary conductors.

Mr. Ries has illustrated his invention in connection with a convenient and easily constructed form of transformer, shown in Figs. 1 and 2. The conductor is wound upon a tubular soft iron core, *B*, having end flanges *A*, *C*, of the same metal, and a threaded cylindrical inclosing case arranged to screw over the end flanges and serving to complete the magnetic circuit. A supplemental laminated core *G*, is also provided, by means of which the magnetic saturation of the transformer can be varied to suit different requirements. In order to adapt the transformer to such cases, where the required translation cannot be effected alone by the difference in sectional area or conductivity of the two conductors, a slotted disk, *F*, of insulating material is slipped over the core *B* near one end, and over this disk is passed the end turn of each layer of the compound winding. The insulation is then removed from the exterior low tension conductor at these points, and connection made therewith by means of binding posts $S^2 S^3 S^4$, whereby the several secondary layers may be connected in parallel, which is equivalent to reducing the number of secondary convolutions and diminishing their total resistance. In this manner any desired electromotive force may be obtained in the secondary circuit from a given primary e.m.f.

It will be observed that reducing the number of secondary convolutions by grouping them in parallel as described does not in any manner interfere with the number of primary turns in circuit, and that each unit length of primary wire is still as effective with regard to the secondary as before. It is also evident that the compound or duplex wire is applicable to any of the well known types of transformers, and will in the majority of cases greatly simplify the operation of winding. In the particular form of apparatus illustrated, no special provision is made for laminating the core and its inclosing shell and for ventilation, although in a slightly modified apparatus Mr. Ries has shown these features. The transformers are applicable to either constant potential or constant current primary circuits, and the compound conductor can also be used to advantage for winding motor generators or continuous current transformers. The patent contains 12 claims, covering broadly the various features described.

Chicago River Lighting and the Tugmen.

The tugmen have never been popular in Chicago. The fact that they have kept thousands of hurrying pedestrians from crossing bridges at busy hours during the day may perhaps explain this unpopularity. It was supposed that the new method of lighting the river by arc lights would assist the tugmen, but they are far from being satisfied. In recent interviews they claim that the electric light does not help them and they complain of the telephone system of signaling. They propose, with the utmost assurance, that teaming be done at night so that the bridges can be turned more often during the daytime.

The daily press of Chicago handles these tugmen without gloves. The *Tribune* says: "It is evident that no aid can be expected from the vessel men or the tug-owners in reducing the bridge nuisance. The council will have to act so as to strengthen the hands of the commissioner of public works, who has done the best that is possible under the existing ordinance. The cool proposal of Mr. Harman [in reference to teaming during the day] is quite in keeping with the arrogant and obstructive attitude which the vessel men have maintained for years."

The *Daily News* treats the subject in an ironical strain. It says, "This interference with the pleasure of a few tugmen in the interest of the million and more inhabitants of Cook county must cease. The tugmen are by nature and training a long suffering race. They have permitted the city of Chicago to erect bridges over the river and pass ordinances fixing certain hours when those bridges may be closed. In the spirit of concession to inferior numbers they have not repudiated the regulations which seek to govern the entrance and departure of vessels by fleets or telephone orders. But there is a limit to concession, a point to yield, beyond which would be cowardice. The tugmen have reached that point. When the commissioner of public works proposes that vessels shall be towed through the bridges as much as possible in the night time he goes too far. The fact that the city has lighted the yellow pathway to the lake by electricity can not affect the desire and undeniable right of the tugmen to work by daylight. If the million inhabitants of Cook county want to use the bridges by electric light the tugmen will not object, but they do object to going up and down the river in the broad glare of the electric lights, while all the rest of the world is sleeping. The idea that the rights and comfort of a majority of one thousand to one should have any weight in the control of the great thoroughfares of Chicago is preposterous. The public is trifling with the magnanimity of a patient race. If carried too far it may provoke the tugmen to destroy the bridges altogether. Commissioner Swift should beware."

Commissioner Swift said in reference to the matter, "As a class, the river men are heartily in favor of the plan of this department, and we have received valuable advice and assistance from some of them. The system of lighting will be extended, and the work of towing will be made as thoroughly easy to be done at night as in the daytime. That is the only improvement which seems now to be necessary." The work will go right on, and Mr. Harman will probably go right on objecting, but that is about all the good it will do him.

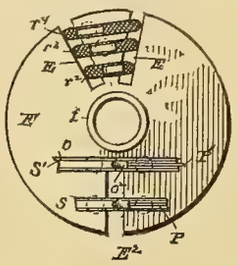


Fig. 2.

Patent Committee's Report.

In connection with the recommendations of the patent committee the following dispatch of a Washington correspondent is interesting: The House committee on the revision of the patent laws has completed an important work on which it has been engaged for some time. This is a radical change in the patent laws as they at present stand. It has been the habit of rich corporations when they become the possessors of a valuable invention to file a caveat and then employ shrewd lawyers to delay as long as possible the granting of the patent. Senator Cockrell's report on the investigation of the department shows that in some cases monopolies have by trivial motions delayed the final issue of patents for eight or ten years. In the meantime, however, the company has enjoyed the full use of its invention, and when the patent is granted the legal term of seventeen years is lengthened by just as many years as the delay has existed. The revision will prevent the recurrence of this in the future, as it is proposed to have all patents either granted or disallowed in two years. The committee will also recommend that the term of an American patent be allowed to run out its entire length, without regard to the expiration of a foreign patent upon the same invention. At present the American patent expires when the foreign patent dies.

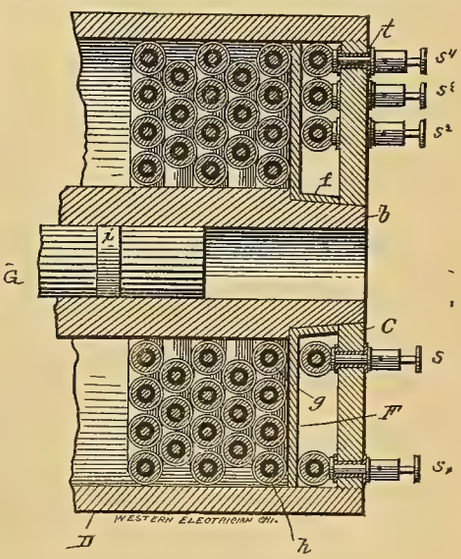


Fig. 3.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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J. WAYLAND CLARK, - -
PHILIP ATKINSON, Ph. D. } Associate Editors.
J. W. DICKERSON, - - -
G. W. PAINE, - - - Advertising Department.

GENERAL EASTERN OFFICE, 181 BROADWAY, NEW YORK.
W. J ARMSTRONG, Manager.

SUBSCRIPTION in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of 4 or more, $2.50, with free extra copy for 8 subscriptions; foreign Countries, $4.00 a year; single copies 10 cents. **Trade supplied by Western News Company.**

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AN association of railroad despatchers has been formed at Kansas City.

THE Chicago North Side cable is still working unsatisfactorily and the officers of the road are soundly abused by the daily press. They take their medicine meekly and do not reply to the abuse which is heaped upon them.

THE Cushman Telephone company proposes to begin active work in Chicago at an early date. The ordinance giving the corporation a franchise has been accepted and the bonds are ready for acceptance by the city council.

THE New York *Tribune* says: "For real rapid transit the cable is out of the question. No surface road can furnish that." Most electrical engineers would agree with the first sentence at any rate but it will not be admitted that the electric motor can not make rapid transit possible on a surface road.

WHAT with daily breaks in the Chicago North Side cable, the occasional stoppage of the South Side grips, the prospect of an injunction to prevent the construction of the West Side cable system, the advocates of this mode of transit do not seem to be altogether happy. The demand for the electric motor is becoming emphatic.

A CHANGE has been made in the standing committees of the new Chicago city council by which Alderman Clarke again becomes chairman of the committee on harbors and bridges in the place of Alderman Tiedemann. This will enable the former to complete the work he began last year for lighting the river by electricity.

IN keeping with new ideas relative to the alternating current system is the illustrated description of a new induction coil designed for use in connection with that system. The inductional apparatus shown possesses several novel features, among which is that of forming a single compound conductor by inclosing the primary within and protecting it by the secondary. We have no doubt the description and illustrations will receive close attention in view of the widespread interest now at its height in everything pertaining to alternating current work.

A CORRESPONDENT writes to the New York *Sun* asking its advice as to the best mode for a boy of 14 to learn electrical engineering. These sensible suggestions are given: "Keep your boy at school; let him learn for some time yet; let him study and learn English, French, and German, for he will need all these languages. Let him study mathematics, and elementary physics, and chemistry, and drawing, both right line and free hand. Then let him go to some person well up in electrical engineering and get his advice; by that time the books we could name now might be all out of date." Most electrical engineers would then advise the young man to attend a thoroughly equipped technical school.

A WRITER in *Dixie* refers to electric lighting in the South as follows: "I am glad to see that the Southern people are giving so much attention to the subject of electric lighting. Unquestionably electricity is 'the light of the future,' and those cities which favor its adoption in preference to gas, are 'wise in their day and generation.' Each year the electric power becomes more and more popular, and each year the gas men are dropping further to the rear. Speaking as a Northern man, with all the prejudices — if they may be so termed — of a Yankee 'technical school graduate,' (and professional electrician,) I can truthfully say that, in my opinion, the South offers a richer field for the electric companies than any other portion of these United States to-day."

THE New York assembly has passed the bill substituting electricity for the halter in the case of criminals sentenced to death. The majority in favor of the bill was 86 to 8 and this fact in connection with the lengthy and careful investigation of the committee having the matter in charge, shows that the members of the assembly must have been thoroughly persuaded of the efficiency and humanity of the former method to have adopted it. Death by electricity will be painless as well as instantaneous, and the wretched, bungling and unfortunate mistakes which so frequently occur will be avoided. Malefactors will never be tortured by the new process nor will they linger, slowly strangling to death, as now very frequently happens. The process is extremely simple and can not fail, and both as a matter of expense and of humanity it will undoubtedly come into favor and thus do away with the unpleasant office of the hangman and his old-time methods, which are out of date in these progressive days.

IN his process of magnetizing steel bars M. Ducretet takes a watertight vessel, in the bottom of which are two pole pieces of soft iron. These are placed upon the pole pieces of an electro-magnet. The vessel filled with the tempering liquid, which can, if desired, be caused to circulate by means of pipes, receives the horse-shoe magnet heated to the proper temperature upon the pole pieces at the bottom, where it is slid to and fro on the surfaces until cold, a current being passed through the electro-magnet all the time. Another method consists of bringing the steel plate in contact with the armatures, the vessel being empty of liquid, and then to fill the vessel rapidly with the liquid. This process gives a good temper to the metal. The degree of temper is not the only consideration. The ulterior work to be done by the bar thus tempered and magnetised also requires to be taken into consideration. An advisable precaution, indicated by the experience of workshops, is to employ two liquids for tempering; a first layer of water, for example, at the bottom of the vessel, covered by a second layer or bath of oil. The passage of the red-hot bar through the layer of oil before it comes in contact with water is found to soften the metal, without depriving it of its power of becoming magnetised.

PROFESSOR F. B. BADT, so widely known in the west as superintendent of construction for the western office of the United States Electric Lighting company left Tuesday afternoon for New York and his future address will be at 120 Broadway, the New York office of the same company.

The necessity for penning these lines is greatly to be regretted although that regret is tempered by the knowledge that the gentleman has deemed it to his interest to make the change.

During the preparation of the DYNAMO TENDERS' HAND-BOOK of which he is the author and the WESTERN ELECTRICIAN, the publishing company, close and intimate relations were established, engendering, we believe, a strong feeling of friendship on the part of the author towards the editorial force of this journal and great regard and great respect, we know, in return.

In the Chicago Electric club Professor Badt will be greatly missed. A man of wide learning and deep research into the profundities of electrical science, well versed in the accomplishments of electricians up to the present time, a man endowed with strong convictions and having the courage of those convictions, he never rose to speak in a discussion, either upon invitation or voluntarily, that the act was not a tacit signal for silence.

Professor Badt needs no introduction to the electrical fraternity of New York, for he is widely known in that city. New York's gain is Chicago's loss, but the loss to Chicago means the professor's gain, therefore we have sped him on his journey with the heartiest wishes for his future success and prosperity.

TO THE literature of the day bearing upon the comparative value of the alternating and continuous current systems for central station lighting we make a valuable addition in this number on the eminently able paper of Professor Badt read before the Chicago Electric club at a special meeting last Monday evening. The key to Professor Badt's position is found in the first paragraph of his paper wherein he says: "I do not believe by any means that the alternating transformer system will be substituted for isolated lighting or for lighting within moderate distances, but I do believe that for an economical central station lighting system, the alternating transformer system is the best in existence." This remark was rendered necessary, inasmuch as lighting within short distances and even isolated lighting had been drawn into the discussion, while he believed that the value of the two systems for central station lighting was the real subject for discussion. A considerable part of the paper is devoted to meeting and answering the arguments laid down by Mr. Leonard in the first paper on this subject read before the club and a perusal and a review of Professor Badt's reply and counter-arguments will serve at least to impress the reader with the fact that the alternating current had in the author of the paper read Monday evening a strong advocate. The paper furthermore has the merit of being specific, that is, is entirely free from generalizations. It can be strongly commended to the reader for careful attention and perusal.

The Chicago Electric Club can felicitate itself upon the fact that it has instituted a discussion that has and is attracting widespread attention in the scientific world. Attention has been called to this fact heretofore but very properly the thought may be reiterated, for as the papers multiply in number so does the interest on the part of scientific men in them increase.

The programme of papers before the club on the "Continuous *vs* the Alternating Current" as originally published in an incomplete state has now been carried out, but the discussion is not to end at this point we are pleased to state. George Cutter of the Thomson-Houston company will appear before the club at the next regular meeting, May 7th, as an advocate of the alternating current; the title of this paper will be: "The continuous current, limited, *vs* the alternating current, unlimited." Geo. H. Bliss will subsequently appear in behalf of the continuous current; the club is waiting for the fulfillment of M. M. Slattery's promise to again appear with data that was not prepared at the time of his former appearance and to W. S. Andrews the club may look for a careful, fair and impartial review at the close of the discussion of all the arguments in favor or opposed to either system. So the feast is not half over yet.

(*Continued from page* 208.)

from a sermon of David Swing: "Nothing is more easily discussed than the unknown. There need be no limit to verbosity. In discussing the locality or nature of Heaven the only reason for ending remark must be found in the muscular abilities of the tongue or in the general respect paid to bed-time. When a group of clergymen discussed last Monday regarding the nature of future punishment, the discussion expired by limitation; the brethren were compelled to adjourn because of the approach of the lunch hour, and also because the next day would be Tuesday, the next day Wednesday, upon neither of which days could a Monday meeting be held." [Laughter.]

MR. ANDREWS: I think from the figures and drawings before us we have as much as we can think about for some time to come, and I certainly agree with previous speakers that the professor has covered the ground very fairly and very fully. It is hardly possible at short notice to bring up any arguments to combat the professor's very careful analysis of the whole subject, but I would say that some two years ago when I was in Milan, they were at that time just discussing the advisability of putting in an alternating system there. The superintendent of the station, a personal friend of mine, was talking to me about it. I would say that the system that they were using in Milan, a low tension system, was 2 wire, not 3-wire; and therefore limited as they were by 100 volts instead of 220 or 230 volts they were obliged to seek some other means of reaching out into the districts that required the light. We all know that with a 2-wire system such as is in use in New York at the present time it is almost impossible to go more than about a half mile from the station without using feeders which are virtually prohibitory from their cost. I think with the professor, and have expressed my views very plainly for the past two years, since I had an opportunity of looking into the two systems on the other side and here, and comparing the two, that the only solution of the problem, is that all cases must be carefully considered and all the different conditions must be thoroughly searched out in every system, and then in the majority of cases I think a combination of the two systems is where true economy can be found. I think that in a closely lighted district, in the middle of the city where there is a great deal of heavy lighting in business offices, for the sake of safety and economy as well that a 3-wire system is the best that can be used. But where we try to stretch out and light the suburbs with a 3-wire system it requires considerable calculation to get the proper distribution. I think, in short, the two systems should unite in a brotherhood and assist each other, and that they should not be antagonistic, and the one say to the other, "I am the great I am."

MR. BLISS: I would like to hear an expression from Prof. Badt as to what system, in a town of five or ten thousand inhabitants, he believes is available.

PROF. BADT: I can only refer again to the conditions. If it is a town that is built close around the business center, that employs cheap power near the center of the town I should think that the three-wire system could be used economically. But I have not seen any such towns. In most cases in towns like that, to utilize cheap power they have a saw mill in the outskirts with a rattle-trap steam engine which can be used during the night for lighting the town, or they have a water power about a mile off; but in such a case I think the alternating system could be utilized with greater economy than the low tension system.

MR. SPERRY: Since last I met with the club, I have been to such a town — a town of seven thousand inhabitants — which is lighted by the alternating current system, and I took occasion to investigate quite thoroughly, as those who are interested both in the practical operation of the system as well as with the financial result of the enterprise were friends of mine. The chief thing that I interested myself in was the coal bill, some indicator diagrams and some statistics with regard to lamp breakage, and I must confess that although I was in a mood to be gratified, I was very much surprised to find that in all these three items they came very near to what is claimed for this system. This system was located on one side of the town, and there were two number 6 wires running in one direction and two number 4 wires running in another direction. The average horse power used was about 60. The number of lights used was over 500, and the machine was running very nicely indeed. It seemed to require no attention whatever. There was a young man around there who claimed to be an expert and talked something about the loss in "leaders," and so on. There were no leaders to talk about however. The distribution, as I have said, was two wires in one direction and two wires in the other direction. The arrangement of the transformers was on poles. The lamps all over the town seemed to be of very uniform candle power and were giving satisfaction wherever I inquired about them. The farthest lamps that were in use I should think were in the neighborhood of half or three-quarters of a mile from the station, and the primary wires and transformers in this locality were very simple indeed. Of course, nothing as compared to the wires required by two-wire or three-wire system. On the whole I was very much pleased with its operation, and I am still to be considered as on the side of the transformer and alternating current system.

MR. WARNER: I have taken occasion to notice during my inspection of a number of alternating current plants the heating of the dynamo, and it seemed to keep the man pretty well on the jump regulating the resistance of the circuit of the field magnets and the resistance in the shunt of the exciters in order to keep the potential constant. As a rule attention had to be paid to those points at least once every five minutes during the operation of the plant, and especially so while the load was varying, and the average time would be five minutes. But when the load was varying a great deal even more attention had to be paid than that. It is very easy to see as the field heats up that there is energy lost there to some extent, and it is therefore necessary to reduce the resistance in the field circuit by cutting out a portion of the resistance in the adjustable rheostats. I was somewhat surprised at the frequency with which this had to be done, and I would like to hear an expression of opinion on this point from those who have had perhaps more experience in this matter than I have.

PROF. BADT: Speaking from what I have seen I must say that what Mr. Warner says is true, but only for half an hour or so after starting the machine and until it gets heated up to a certain point, and after that, providing the speed of the engine, or whatever it is, is uniform, the alternating dynamo is a better self-regulating dynamo than any continuous current dynamo I have ever seen. This matter which Mr. Warner refers to will, I think, be explained in a few cases from the fact that alternating plants have been put up in a great hurry and those in charge did not think it necessary to run an extra wire for the pressure or potential indicator back to the station from the main distributing point. Suppose you run a couple of feeders even with an alternating system at two and a half or three per cent. loss a mile or a mile and a half before you have any lighting, and you connect the potential indicator directly with the two mains at the station. The potential indicator, of course, will show the variations of the dynamo and the variations of the pressure, in a long lighted district. Now you commence to turn the lights off; the engineer will still try to keep the pressure at the dynamo constant. If these pressure wires have been run properly and the potential indicator performs its proper functions, in a half to three-quarters of an hour after first starting up the field has become heated to its normal degree, and then I do not think that those objections can be raised which Mr. Warner had mentioned. As to the heating of the dynamo itself I would say that I have seen a couple of cases, where the engineer thought it necessary to reduce the speed of the engine to lessen the electromotive force of the alternating dynamo and speeding up the exciter without increasing the speed of the alternating current dynamo; which necessarily must heat the field considerably more than it would under normal conditions.

THE PRESIDENT: I would like to know which companies use the alternating system in this country.

PROF. BADT: I think the Westinghouse, Thomson-Houston company, the Fort Wayne Jenney company and the United States Electric Lighting company are about all.

THE PRESIDENT: Do all of the alternating dynamos use the exciter?

PROF. BADT: As far as I know, yes, sir. All the dynamos used here use an exciter for excitation of the field.

THE PRESIDENT: I would like to hear from Mr. Cutter on that subject.

MR. CUTTER: I can answer that last question. Machines of 500 lights which we manufacture are self-exciting.

THE PRESIDENT: What company is that?

MR. CUTTER: The Thomson-Houston. There is a separate winding on the armature which we use for exciting the field magnets. That, of course, has its best advantage in small plants where you have but one machine running. For larger plants it is probably best to use a separate exciter.

In relation to the heating of the dynamos I think that we all had considerable difficulty in the beginning, but we are not having much of any difficulty on that score at present. I think we understand why we had it first. It was a matter of construction of the machine. The alternating current is a peculiar fellow and was not very well understood.

In relation to the mixing of the different systems in the same station there seems to be quite a general impression in favor of it, and I think I shall have to be the black sheep in the flock. I do not believe in mixing matters in any such a fashion. I believe that the successful electric lighting station is a station of uniformity in its apparatus. Uniformity is not of so much importance until you come to the engines, dynamos, measuring instruments, switch board apparatus, and so forth. There uniformity is considerable of an item, where repairs and attention are taken into consideration. Of course, as I became a convert quite a spell ago I am quite pleased to hear the advocates of the continuous current put forth this argument, as it appears to me that it is more or less of an admission on the part of the arguments that we offer, showing that they feel their limitations, and they are sort of clinging to a straw for a little bite of the business. What my company will say to me for being so decidedly in favor of alternating currents I do not know. But as a technical man I believe in the alternating current system. Start with something that gives you the ability to reach everybody in town who requires light, for it is light that we are renting. Do not start in with a system that will work well for a small area and remain there until patience ceases to be a virtue and you can induce the directors of the company to pull out their pocket books for an extension of the system with another set of apparatus. There is another peculiar feature of such a mixed station. In all probability the continuous current machines would have a corner by themselves and the alternating current machines a corner by themselves. And then if you had two or three types of each they would each have their own corners. And I suppose that the operators of such a station would have a guide to tell them which corner to work in. My experience with workmen, handling both, is that those who have charge of the apparatus, even though they are men of long experience in continuous current work, when they handle the alternating current for a while they do not want to go back to the other. Now, if we had a mixed station, the continuous current dynamos in their corners, and we had men working there and they had a taste of the luxury in the opposite corner they would certainly drift over that way. Another feature would be that the flexibility of the alternating current would be readily appreciated by such a comparison by every person connected with the enterprise, from the man that furnishes the money to the fellow that does the dodging about from instrument to instrument to keep the apparatus balanced. If you want to make any change in the service for the continuous current you must go through an intricate calculation to do it. You must have a man there who has a head on his shoulders for that purpose. If you wish to make a change in the alternating current it may involve a slight calculation, but one that is extremely simple. And that system is therefore easily adaptable to the varying conditions that will arise after your station is put in order.

MR. BLISS: I would like to ask those gentlemen who are advocating the alternating system if they put their converters in multiple arc?

MR. CUTTER: I presume I understand Mr. Bliss to inquire whether we put the primaries in multiple arc.

MR. BLISS: Yes, the primaries.

MR. CUTTER: That is the practice at present, universally. In the first work that was done with the converters they were put in series in some of the underground stations in London. That was not a success; the converter was not a success, until it was put in multiple arc.

MR. BLISS. I want to say that I am not opposed to the alternating system. On the other hand, I think there is no one who has more cordially welcomed it in the field of electric lighting than myself, because it has extended the usefulness of electric lighting very largely, and, of course, is going to occupy a large amount of territory. But I do hope these friends who are such strong advocates of the alternating system will not lose any sleep in worrying about the constant current system. It is a fact, you know, that there is going to be a thirty-thousand Edison Light station in the city of Chicago, and there are at the present time going into the city of New York two very large Edison stations, and the capital that is being furnished for those stations comes very largely from the same persons who made the investment in the first large incandescent electric light station that was put in in the United States. They appear to be perfectly satisfied with the returns which they have thus far received, and are perfectly willing to make this investment of a very large sum of money to carry forward their style and their method of doing business. Now, there are one or two points that I want to call attention to in favor of the Edison system — not particularly the Edison system, but the continuous current — and that is, that the wire and machines are put in not always as you see them on that paper, running on a single route where they might by a violent sleet storm be thrown down or the system be thrown out of order.

Attention has been called to the fact that a continuous current station, located centrally where real estate is costly, creates a large item of expense, as against it, as compared with the alternating system. Of course that is true, but I want to call attention to one fact, and that is, that the renting or selling of exhaust steam in the Edison station here, or in any other large electric lighting station centrally located, is going to become a large source of revenue to the company and that, to a certain extent, will become an offset to the additional cost of real estate for a station so centrally located.

THE PRESIDENT: I think they are putting the wires underground in the large Edison plant in New York. I have noticed that a number of times, and it looks to me as though it was a very large investment and the people must have thought that system over carefully before they put in so much money as they are putting in there.

MR. CUTTER: Mr. President, I do not want to say too much in favor of the alternating system, because I think of preparing a dissertation myself on the matter, but the discussion has aroused not a little of my enthusiasm for the question. I realize the force of the point put forward by Mr. Bliss. That careful business men who have had an experience with the continuous current system are ready with their money for more of the same sort, and therefore those men are putting in a large station in the city of Chicago is true. But all I can say is, I am sorry for them. They may realize a certain benefit from their investment, but they are shrewder business men than I am to see it But the fact seems to me still more prominent that they have paid dearly for a bit of land for their station. They have paid dearly for a system of underground work which has all got to come up inside of five or six years; instead of having a system where the land would have cost them very much less, and the building could probably have been erected at less expense and where the handling of coal and ashes and things of that sort would have been materially less. I would differ also with Prof. Badt in thinking that the business blocks of Chicago should be lighted with a 3-wire system or any continuous current system when the transformer is just the fellow you want for the place, when you run out a few small wires and tap into the main wires almost anywhere without much regard to the first calculations that were made for such a plant. Now, those wires for a transformer system would be simple, and the probability is they would be drawn into conduits, and if any one of them went wrong they would be withdrawn in sections and others put in their places, a feature of engineering that is in my mind the only safe method of engineering for underground work, and is not admissible with the large apparatus required with the 3-wire system. Now, the station at Milan is one with which I am very familiar. They have a large network and they are taking it pretty much all out. It is a matter of experience with iron pipes underground, that they will not stand more than about so many years, five, six or seven or eight years, according to the soil, according to the amount of labor that is being done in those streets, repairing the sewers, gas pipes, water pipes, and things of that sort. In relation to reliability I must decidedly take exceptions to the position of Mr. Bliss. I consider the converter system with equal engineering ability more reliable than the 3-wire system. We have had annoyances from this score, we realize. That annoyances have also occurred from the 3-wire system we also realize; as one instance, with the station at the Holton viaduct when a feeder blew out; a feeder fuse blew and that threw the load on to another feeder, which could not stand the strain, and blew that fuse, and then fuse after fuse went until the lights were all out and the viaduct was left in the dark. That was of course early in the history of such stations. We had an experience somewhat similar in the transformer stations, but it is no longer necessary, and with equal engineering ability is not at all liable to happen.

MR. ANDREWS: I would like to say with regard to the difficulties that my friend Mr. Cutter speaks about in underground conductors, about their being obliged to pull them out in the course of four or five or six years; he draws that conclusion from the fact that many of the conductors which were put down five or six years ago, in the early stages of the business, when we did not know so much about it as we do now, undoubtedly have had a great deal of repairs, and some of them will have to be taken up. At the time they were put in, very thin iron tubes in comparison to what are now being used were put down, and they were not of sufficient strength to withstand the destructive nature of the soil. But I think that the tubes that are now being put underground are likely to stand a long time, and I draw that conclusion from the fact that even some of the earlier tubes which were put down in New York and which have been there for five or six years, are doing good service at the present time, and show no signs of depreciation so far as the light is concerned; I do not think it is hardly fair to say that because some of the earlier work that was put in, when we knew so little about it, has to be pulled up there is no improvement in this branch of the business at the present time, and that those that are now being laid underground will certainly have to be pulled up within the next five or six years. Indeed, I should be willing to put a little money upon it that they will not be pulled up. I think they are put there to stay for a much longer period.

THE PRESIDENT: Mr. Godfrey is present and I would like to hear from him.

MR. GODFREY: I do not feel like entering into this discussion, because I come from the east where we have not discussed the alternating system, and I do not pretend to know very much about it. But I would like to say this about the question of expense of land: I come from the city of Boston where we have got a very large Edison station, and we are putting up a building, that will cost us something like $150,000, right in the heart of the city. We propose to occupy the first two floors and to build five stories higher and rent them for offices, which will give us a pretty fair return for the money, and, in fact, it is so desirable a location that real estate agents have offered to lease the four upper stories for the next five years and put the building up themselves without one cent of expense to the company. Then on the question of the removal of ashes and the supply of coal. In that city it costs no more to have coal delivered in that station than it would if it was within two blocks of the water's side. It costs no more to remove the ashes than if the station was three miles from the center of the city, because the ashes have to be carted to what is called the dump, and it costs but 25 cents a load whether it is carted three miles or a half a mile. I think that it is a mistake that our alternating friends are making when they say that the location of the station is a great object.

PROF. BADT: I hope that real estate and other speculations will not be dragged into this discussion. We can prove very easily anything that anybody wants to, one way or the other—it does not make any difference at all what it is. I would like to know in what way speculation in real estate has anything to do at all with the question of cheap distribution from the central station. Why, we might open a grocery store in a central station and grind coffee with the power that is generated in that station. All these things, of course, can be done, but how that has anything to do with the question at issue, namely, which is the cheapest system for the distribution of electricity for central station lighting, I do not know.

THE PRESIDENT: I think, Prof. Badt, that Mr. Godfrey's remarks were pertinent to the question, because it has been stated here that one objection to the continuous current system was that it had to be centrally located and the cost of real estate was so large. He simply shows that by a proper means the cost of real estate need be but very small and that the station may still be located in the central portion of the city. As far as the point of expense is concerned it seems to me that Mr. Godfrey's remarks are pertinent to the question before us.

MR. CUTTER: I do not wish to be popping up and down too much, but of course we have got our notions on all these questions that come up, and my notion is that the answer to that criticism about the location of the station has very little force. If some real estate agent is going to start a building and run the stories up to the heavens why not let him take the most valuable part of that property and let him have the first, second and third floors which will rent, if my ideas of real estate are correct to greater advantage than the fourth or fifth up to the twentieth. Now then, put your station where the property is of less value and let the electric light company use the $150,000 property in the center of the city—make it all a business block and do not use the richest part of it for an electric light station.

THE PRESIDENT: It may not be exactly pertinent to this question, but it strikes me that all these electric light stations centrally located, if the plans were properly made, could be made so as to cost but very little. The same thing would apply, of course, to alternating systems, or anything else.

MR. WARNER: It strikes me that this matter of real estate is very pertinent to the question. You see in very many cities express companies and other companies putting up large buildings, of which they occupy certain portions and rent the rest and for a very good business reason.

Now, apropos of the matter of uniformity in stations, Mr. Cutter has pronounced himself to be strongly in favor of uniformity. I may say that I have advocated that to a great extent myself, and I would not advocate or advise mixing the systems if I did not see engineering advantages and advantages that I thought good engineering made plain. We find in almost every manufacturing establishment different classes of work to be done. They do not attempt to do all those different kinds of work with one machine or with one man. They have different machines for the different classes of work. They have different workmen for them. They do not attempt to put a man who runs a heavy planer at work on a speed lathe. They do not attempt to put the man who does brass polishing to work at cast iron chipping. As to the last statement Mr. Cutter has made in regard to the men not liking to change work, they cannot do the work. The average man is not capable of changing work, but it has to be changed for him.

MR. ANDREWS: I understand that the company that Mr. Cutter represents is going very largely into the electric railway business, and I should like with your permission to ask Mr. Cutter what system he is going to use in that business.

MR. CUTTER: We appreciate the merit of the question most assuredly, and we appreciate it most severely when we make calculations for very long lines. Although we have a very good system for that purpose by virtue of various deals and combinations, we still feel that we would like the alternating current to get there, and get there it will. The flexibility of the alternating current is going to make it the proper current for electric railways because you can run a small line or you can convert it to whatever you choose. Now, we are prepared to make calculations upon every phase of the electrical problem that comes up concerning the developing of energy, and a man situated as I am in the mechanical department of a large company called upon to make estimates and give opinions on the proper means of distributing that energy realizes the limitations of the continuous current—we should realize it most forcibly. If that man has any ambition to cover the conditions that arise he grows in his enthusiasm for the alternating current; he will go here and there in search of knowledge and will not be circumscribed.

MR. ANDREWS: Mr. President, let me say to Mr. Cutter that he has not answered my question.

MR. CUTTER: I implied, I think, in my answer that we were using the continuous current and we had to figure accordingly. And, I also say, that we expect to use the alternating current. At the present, of course, we use the continuous current.

MR. SPERRY: Were it not so late I should like to ask for more discussion on the question of power. It seems to me that that is rather an important matter. The question of the coal bill is a serious one. The transformer system has been accused of wasting energy on every corner, and if that is so there must be extra energy given into the machine, and there must be more coal consumed in that plant than in the continuous current plant of the same size. On investigation it seems to me that this excess of coal bill does not exist and the amount of energy that is shown to be wasted in the leads or in the machine or primary, or converter, does not seem to exist. Now, the other item is the expense of the maintenance of a plant. That is depreciation, wear and tear. I, for one, fail to see anything about a converter that is going to deteriorate to any great extent. It was brought out, I think, in one of the papers, that a large amount of the expense of the converter was represented by labor. Labor is going to be just as valuable a commodity fifty years from now as to-day, and the fact that any of its machinery is represented largely by labor I fail to see is an argument against it in the matter of depreciation. And this matter of actual coal bill and lamp breakage it seems to me is very essential and one that lies near the roots of this discussion. I should like to hear from some one who has had the supervision of several stations perhaps in regard to this point if it does not take too much time.

THE PRESIDENT: I think as near as I can remember that that subject has all been gone through with here in previous papers and in previous discussions at these meetings. If there is any one who has any information to give on this subject we would be glad to hear from him.

MR. CUTTER: I will offer a further remark, but not to try to give the information that Mr. Sperry calls for. I agree with him that it lies at the root of the matter. I remember when I was a young fellow somebody, told me, or I read, that figures will not lie. I say they will. They are awful liars, and just the moment we commence to argue the question of coal and heat we are entering upon just that kind of ground. All sorts of data can be advanced. Our experience at present being large in both systems we are prepared to rent a certain number of lights for less coal heat with the alternating system than with the continuous current system.

Another thing, we do not know the actual voltage of the alternating system. Whether a thousand volts means a thousand volts or two thousand volts or five hundred volts we do not know. Now, if it means a thousand volts then it means that a 16 candle power lamp gives an equal benefit for illuminating purposes to the eye, at any rate, with much less energy than a continuous current, for the simple reason if you take a 50 volt alternating current, all the waves on top of the neutral line, the zero line, and then draw a straight line which represents the continuous current in 50 volts there are a good many spaces left that the alternating current has not touched. The energy of the two would of course be represented by the areas of such a diagram. Such a diagram of course would have to be drawn to represent the idea.

The club adjourned to Monday evening, May 7th.

Press Comments.

CONTINUOUS VS. ALTERNATING CURRENTS.

Practical Electricity, March.

Mr. Leonard's paper printed in this issue, on the subject of "Alternating *vs.* continuous currents," is worthy of the closest perusal. At the present time, there are practically in operation in this country two distinct systems of incandescent electric lighting; namely, the continuous current system, of which the Edison is a type, and the alternating current system, of which the Westinghouse is a type. Thus far, both of these systems have achieved wide reputations, and have met with great commercial success. It so happens, however, that the friends of one system are very decided opponents of the other, and the arguments advanced, *pro* and *con*, are so forceful, and, we might add, so apparently conclusive on either side, that whosoever shall venture to form his opinion without weighing both sides of the question may possibly find himself mistaken in the end. In his paper, which, as we have already stated, merits to be carefully read by all persons who meditate the placing of capital in the electric lighting business, Mr. Leonard questions both the economy and the safety of the alternating current system, and at the same time believes that its usefulness, commercially speaking, is restricted to the production of *light* only; while, on the other hand, the range of utility, credited to the continuous current system, is practically unlimited for heat, light or power purposes. In our next issue, we shall print a reply to Mr. Leonard's argument.

Science, April 6th.

In considering electrical questions with view of deciding between two systems [alternating or continuous current] we should consider two things—economy under present conditions, and the probable progress in the near future. As things stand at present, we may say that the direct system has the disadvantages of a limited area of distribution, and the necessity of locating in a central position, where land is expensive: the alternating system has the disadvantage of a considerably greater loss in distribution, of greater complexity and consequent liability to accident, impossibility of distributing power, and danger. These considerations would point to the direct system being best in the central portions of cities, while the alternating system should be used for towns and for the suburbs of cities; possibly, too, as an auxiliary to arc lighting stations.

In the future the alternating system can hope for the perfection of a motor and the general improvement of the apparatus: the direct system can hope, besides the ordinary improvements, for the perfection of some converter for direct currents; above all, for storage batteries. If storage batteries are successfully developed, the alternating system has nothing to offer that the direct system does not possess, while the advantages of the latter will be overwhelming. As we have already pointed out, however, a combination of the two systems would undoubtedly be best at the present moment.

Lamp Lighting Schedule—Moonlight System.

MAY.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**7.30**	1 50	6.20
2	**7.30**	2.30	7.00
3	**7.30**	3.00	7.30
4	**7.30**	3.40	8.10
5	**7.30**	3.50	8 20
6	**7.30**	3.50	8 20
7	**7.30**	3 50	8 20
8	**7.30**	3.50	8 20
9	**7.30**	3.50	8 20
10	**7.30**	3.50	8.20
11	**7.40**	3.50	8 10
12	**7.40**	3.40	8.00
13	**8.30**	3.40	7.10
14	**9.20**	3.40	6.20
15	**10.10**	3.40	5 30
16	**11.00**	3 40	4 40
17	**11.50**	3.40	3 50
18	12.20	3.40	3 20
19	12.50	3 40	2.50
20	1 20	3 40	2 20
21	2 00	3.40	1.40
22	2.30	3 40	1.10
23	No	light.	0.00
24	No	light.	0.00
25	No	light.	0.00
26	**7.50**	**9.40**	1.50
27	**7 50**	**10 40**	2.50
28	**7.50**	**11.40**	3.50
29	**7.50**	12.30	4 40
30	**7.50**	1 10	5.20
31	**7.50**	1 40	5.50
	Total number hours,		158.20

The foregoing schedule is practically good for the United States
The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.
The time for lighting or extinguishing is given for the day on which the night commences.
The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

Brush Company vs. The Western Electric Company of Toledo.

In the suit of the Brush Electric company against the Western Electric Light and Power company of Toledo the testimony of the complainants is nearly completed. The suit was instituted on the double carbon arc lamp patented by Charles F. Brush in 1879. The plaintiff company hold that the lamp used by the Toledo company is an infringement. Testimony has been taken at Boston and Toledo. In the former city the taking of depositions began February 8th and continued to the 18th. One deposition of Prof. Cross of the Massachusetts Institute of Technology was taken. In Toledo the taking of testimony continued seven days. Three employes of the defendant company were

examined, after which Thomas E. Adams foreman of the testing department of the Brush company testified. Probably no man in the United States has a more accurate practical knowledge of electrical lamps than Mr. Adams, who is an inventor and an expert. The complainants are now closing their testimony by taking the deposition of Prof. Morton of the Stevens Institute of Hoboken. George P. Barton of Chicago, attorney for the defendants, and Milo P. Kellogg of the Western Electric company of Chicago are in attendance. After the examination of Prof. Morton the testimony of the defendants will be taken in Chicago. It is understood that Mr. Kellogg and Thomas D. Lockwood will give expert testimony in behalf of the defendants.

The Waterhouse Regulator.

At an exhibition test of capacity for regulation of the output of current from the Waterhouse system dynamo, made in Hartford, Conn., a few days ago, at which several representatives of the electrical press were present, novel and interesting features were shown. The regulation is entirely an electrical balance, not depending on any magnets, solenoids, brush shifters, or other movable devices whatever. The brushes are stationary and to the casual observer the regulation is a mystery. The machine is series wound. The test was made on a 35 light dynamo, the lamps consuming each 9¼ amperes, with 45 volts fall of potential. An accurate ammeter was placed in the lamp circuit, and another in the field circuit. The test was made repeatedly by both cutting out and introducing lamps, and the following were readings taken:

	Current in the circuit.	Current in the field.
35 lamps, (normal arc).....	9.25 amperes	6.00 amperes
20 " "	9.25 "	4.75 "
15 " "	9.25 "	4.00 "
10 " "	9.25 "	2.75 "
5 " "	9.25 "	2.00 "
1 " "	9.25 "	1.25 "

At the instant of change of lamp load there was no sudden overthrow of the instrument readings; the needle quietly moved to its new position and remained until the next change of lamp load was made. The operation was striking in that those present were accustomed to look for more or less momentary oscillation of the current at the instant of cutting in or out any considerable number of lights. The details of this system of regulation for constant current are not yet made public, but the figures given above are reliable, and point to a high efficiency of the machine.

CORRESPONDENCE.

From Kansas City.

KANSAS CITY, MO., April 21.—This city is about to have an electrical exchange. The Bank building at the corner of 5th and Delaware streets has been selected as headquarters. Among those who have already secured offices in the building are the Kansas City Electric Light company; The Edison Electric Light and Power company; The Electrical Supply company; The Thomson-Houston Electric company; The Western Electric Construction company, as well as several representatives of engine and boiler manufacturers. The building is centrally located, has just been rebuilt and refitted and is wired throughout for incandescent lights as well as other modern electrical appliances.

At the office of the Inter-State Electric company your correspondent found the genial Superintendent Paul Bossart busy making contracts for the storage battery system. He has just closed for a 400 light outfit for Missouri Valley, Iowa. All of the company's Kansas City plants have been enlarged during the last four months. An additional dynamo for charging accumulators has been purchased for their Moody central plant at the corner of Missouri avenue and Delaware street. It is of the Fort Wayne Jenney make.

C. H. Cone of the Electrical Supply company reports, among others, a large order for wire and supplies to go to Horton, Kan., where the Hawkeye systems of arc and incandescent lights are being placed.

At the Electric Supply company's office the writer had the pleasure of meeting F. S. Terry, their manager, who came on a flying trip from Chicago to look after their Missouri and Kansas trade generally. He reports their western business better than ever, making larger quarters for their Kansas City office a necessity.

C. Kammeyer of the Fort Wayne Jenney company is busy installing an arc plant for the Metropolitan street railway to light their new 12th street cable line. Ten of the patent O'Beirne mast arms will be used to illuminate the incline between Lincoln and Sante Fe streets, as well as several curves and crossings. Mr. Kammeyer also reports the sale of two dynamos to the Inter-State Electric company for charging accumulators, one to go to Missouri Valley, Iowa, and another for an increase in one of the Kansas city plants.

O. W. Ditsch, the smiling superintendent of the American Electric Light company, started their new station on the 15th inst., with 58 arc lights. The lights of course, were a "howling success." They have at present 13 miles of circuits, all run in "P. and B." wire. The demand for their light is such, that they have had to order additional machinery.

E. R. Weeks of the Kansas City Electric Light company reports business rushing. He has a large force of men at work wiring for arc and incandescent lights; and replacing most of the underwriters wire in use, with okonite or kerite insulation. It requires considerable "nerve" to make such an expensive change, but there is no doubt it will pay in the end. Brother Haskins will have to look sharp, or the village at the Kaw will be ahead of Chicago, as far as "high" insulation is concerned.

With the spring boom in the building line, the electric bell hangers are in their glory. All of them report business brisk.

Ford Caldwell of the Western Electric Construction company is on a visit to Colorado in the interest of his company. This company is wiring the new board of trade building for incandescent lights, using kerite wire throughout. The ever jovial Col. Glasier, better known as "Pop" Glasier, of the Jarvis Engineering company, was a caller last week, and between the puffs of a Victoria Regina, gave your correspondent a long list of plants where the Jarvis boiler setting has lately been adopted.

W. J. Buckley, of the Fort Wayne Jenney company, spent last Sunday in our city as *usual*. He claims the new Slattery converters will convert the most skeptical customer to the alternating faith.

[AFTER—A LONG WAYS AFTER—TENNYSON.]

In the spring a lot of crosses
Come upon the arc light wires,
And whene'er it starts a raining
We have lots of little fires.

In the spring the gay promoter
Asks a franchise from the town,
Wants to bury all the circuits,
Says, 'twill put the danger down.

In the spring the city council
Wrestles with the conduit plan;
And when up comes this same ordinance,
Votes against it like a man.

P.

From the Pacific Slope.

SAN FRANCISCO, April 18.—The California Electric Light company has purchased a site for a new station.

O. L. Hall, agent for the Leonard & Ellis oils on the Pacific coast, reports that the sales of dynamo oils have increased 300 per cent. in the last year.

George T. Emery has invented an electric drill. One of the machines can be seen in operation at the rooms of C. A. Fisk, agent of the Buckeye Engine company. The cost of installing a drill of this kind is about one-tenth of that of an air compressor plant. About one-tenth as much power is required. The drill steel hammer strikes from 150 to 250 blows per minute. The drill will probably be brought into general use. The current is supplied by the Pacific coast Electric Construction company.

Last week John J. Bonner, manager of the American District Telegraph company, was arrested on the charge of sending a thirteen year old messenger to a house of ill-repute, contrary to a statute of 1887. The law reads as follows: "No minors in the employ of any Telephone company, Special Delivery company or association or any other corporation or person or persons engaged in the delivery of packages, letters, notes, messages or other matter, shall be assigned by such corporation or person or persons to hire such minors to keepers of houses, variety theaters or other places of questionable repute, nor permit them to enter such places of illegal or questionable calling; that this law apply alike to managers, superintendents and agents of such corporations, and to be enforced against them."

Mr. Bonner does not deny the charge but claims that the law is unconstitutional as it discriminates against common carriers. There are about 400 messengers in this city.

The Livermore board of trustees has awarded the contract for lighting that city for the next three years to W. C. Clark, of the Waterhouse company.

An electric light plant is being built at Phœnix, A. T.

The Electric light company at Fresno has increased its plant. S.

Indianapolis Items.

INDIANAPOLLS, April 21.—The specifications prepared for bidders for lighting the city by electricity have brought out some adverse criticisms in regard to several of the requirements. Mr. Chipman, of the American Lighting company, makes this criticism of the specifications: "If the contract with the city is to be based upon the specifications, unnecessary burdens, which will increase the cost of the plant, are imposed, and there are some conditions asked for that are electrical impossibilities. It is required in the specifications that not more than fifty lamps be lighted by any one circuit. In some cities a hundred or more lamps are lighted by a single circuit. To multiply circuits is to multiply cost. Engines, it is stipulated, must have uniformity of speed, which is essential; but the engineer requires further that each dynamo be provided with an automatic current regulator, which will maintain constant currents under all conditions of speed. Ths last requirement is, I think, an electrical impossibility in the state of the art today. It is also provided that each dynamo will be required to light fifty lamps under normal conditions. The effect of this will be to cut off several companies from bidding, if the absolute letter of the specification is held to. It seems to me that the engineer and the council should, as information is what is wanted, permit companies to submit bids for a plant that will meet with the general requirements of the specifications, but that need not be held to the rigid construction of the specifications. It is also an injustice to require companies who bid to submit a bond of $5,000. It is time enough to file a bond when a contract is given, as the city can suffer no damage from the bidders."

The city civil engineer says that he makes no profession to being an expert electrician, but that he has received assurances from competent sources that his specifications are carefully drawn and reasonably satisfactory to the various competing companies. Representatives of several companies have taken trouble to compliment him on his specifications. These gentlemen have told him that the bond requirement is usual, and that he has justly guarded the city in inserting it. If a company should wish to bid for the purpose of defeating electricity, it would not want a bond; if it is acting in good faith, he sees no reasonable ground for objection. As to the fifty lights to the circuit, the engineers says that the reason he has required it is that in case of a break in the circuit no large portion of the city would be left in darkness, but that only fifty lights would be displaced; as to the dynamos thirty or or thirty-five light capacity would be too light, and two such dynamos for each circuit would make so powerful a current that great danger would result to firemen or any who might be obliged to touch the wires in damp weather. In brief, Mr. Shearer says that any company may submit bids that will be considered if the main provisions, calling for a first class plant in all respects, are complied with, but that he is unalterably opposed to permitting any company which furnishes the light to supply its own specifications, as that is the way the city has heretofore been inflicted with bad jobs. M.

THE ELECTRIC LIGHT.

The Brush company has received a contract for illuminating Charleston Ill.

In Philadelphia last year 354 arc lights were used for electric lighting at a cost of $87,974.58.

The charter of the San Antonio, Texas, Gas company has been amended so as to enable it to supply electric light.

The city council, of Little Rock, Ark., has appropriated $27,000 for the purchase of an electric light plant for lighting the streets.

The Paris Gas and Electric Light company, of Paris, Ky., will enlarge its gas works and will increase the capacity of its electric plant.

The London and Brighton Railway company have now fifteen trains lighted by electricity, two running between London and Brighton, and thirteen others which are local.

The Sven Tideman Electric company of Grand Rapids has changed it corporate name to the Peninsular Electric company. No changes have been made in the organization or management.

The foreign shipments of the Brush Electric company have been very large of late, and heavy orders have been filled for South America, Mexico, China and Japan, as well as other countries.

A man who fell to the ground in the street in New York city last week was supposed to have received a shock from an electric light wire. It was subsequently learned that it was not "electric fluid" but an altogether different variety which caused his steps to totter.

The capital stock of the Fort Worth, Tex., Gas and Electric Light company has been increased to $300,000. The gas works will be considerably enlarged during the summer, and an electric plant put in. The latter will embrace both the arc and incandescent systems.

The Washington and Virginia Underground Conduit and Construction company, has applied to the commissioners for permission to lay underground wires for electric light and power purposes in the streets. They offer to furnish electricity at a cheaper rate than is now charged.

The Kansas Electric Light company of Thayer has been incorporated. The officers are: C. T. Ewing, president; C. H. Zabriskie, secretary, and C. A. Mitchell, treasurer. The company has a plant in Cherryville, and will have one at Thayer, and contemplate working at other points.

Kingston, N. Y., is agitating the subject of electric street lighting, and with some prospect of finally adopting it. Mayor Newkirk, in a recent message to the city council, mentioned the probability of such a step being taken, and thought it wise for the city to operate the plant instead of allowing control to be invested in individuals.

The eleventh annual meeting of the Western Gas Association will be held in Chicago May 9th, 10th and 11th. The headquarters will be at the Grand Pacific hotel. Among the papers to be read are the following: "Fuel Gas," by Walter Clark; "The Cost of Arc Lighting," by C M. Keller; "Incandescent Gas Burners" by Edward Lindsley.

It has already been noted that by a new regulation the use of electric light in Madrid theaters was made compulsory. The change must be made within six months. The royal decree states that all dynamos, engines and motors of any kind are to be completely isolated from the main building, and in fact stringent rules are laid down to render the installations safe.

General Agent Church of the Westinghouse company recently said to a reporter: "Texas is advancing in the use of electric light very rapidly. We have more central stations there than in any other state of the union. We have only lately established stations at Houston and Marshall. The chief reason for this appears to be that the cost of coal there is considerable, which makes artificial gas accordingly expensive."

A committee was appointed some time ago in Berlin to make a series of experiments with underground cables for electric lighting purposes. The experiments were made partly with sections of cables used in central station supply systems and partly with cables specially laid for the purpose in the works of Messrs. Siemens & Halske. The experiments are now nearly completed, and the results will be communicated at an early date in the form of a paper on underground conductors to the Berlin Society of Electricians.

"In three years more gas street lamps will be a thing of the past, just as tallow dips and kerosene oil have successively been." Such is the opinion of Mr. David Kidney, and if any man has a right to an opinion on the subject he has. Mr. Kidney has been a street illuminator for twenty years past. In old times he was a practical operative lamplighter himself in the Seventh ward, but for eleven years has been superintendent of the district lighted by the old New York Gas company, now Branch number 1 of the Consolidated Gas company.—*New York Sun.*

Welcome as the development of the electric light is anywhere, says the London *Daily News*, there is no place where its final adaptation to popular wants will be a greater source of comfort and pleasure than in the railway carriage. Nothing so much exasperates the traveler, already suffering from the tedium of a prolonged railway journey, as a bad light; while the thought of the pleasure that would be given daily to millions by the provision of a bright lamp on our railway lines ought to be a sufficient incentive to an endeavor on the part of the railway companies to supply such a want.

Alterations are being made in the central station from which the Vienna opera house is supplied. When the steam dynamos were first erected the vibration communicated through the walls to the adjoining buildings was so great that in some rooms it was impossible to write, and the owners of the property began legal proceedings, with the result that the Gas association was ordered to discontinue the nuisance on a penalty of 5,000 florins for each infringement of this order. To overcome the difficulty the company have laid down an enormous foundation block of concrete, on which the steam dynamos are placed. This block is completely detached from the walls of the building, so that no vibration of any kind will be communicated to the neighboring houses.

The prospect for electric lighting in Paris is not flattering, it is stated, on account of the conditions imposed on contractors. The maximum price for a 16 candle power incandescent light is fixed at 4½ centimes per hour. The employes must never work more than nine hours daily, and their minimum wages are fixed at 80 centimes per hour from 6 a. m. to 6 p. m., 1 franc 20 centimes from 6 p. m. to midnight, and 1 franc 60 centimes from midnight to 6 a. m. A yearly payment of 100 francs for every kilometer of wire or fraction thereof laid in the public streets is to be made to the city, with a sum representing 5 per cent. of the gross receipts of the company. The most absurd regulation is the following: "The wiring will take the form of segments of a circle, going from the center of Paris to the fortifications, and the companies must undertake to be ready to furnish the light to every part of their concession within four years." This regulation alone is sufficient to prevent any company from asking for a concession; the distance from the center to the fortifications varies from 6 to 10 kilometers, and if the consumers are pretty numerous within the 3 or 4 first kilometers, they will be very scarce for the rest, although the company would be bound to lay wires up to the last meter and to give light to the last house, even if it were only asked for a single lamp.

The Riga theater, says *Industries*, has been fitted with an electric installation of considerable size. The three large dynamos are collectively capable of lighting 1,500 20 candle power glow lamps; but as only 1,000 lamps are required for night use the third dynamo is in reserve. For the day service, when only 142 lamps are required, there is provided a separate small dynamo, driven by a 12 horse power steam engine. There are in the theater three distinct circuits—one for the day service, feeding 142 lamps, and the two others for the night service, feeding collectively about 1,000 lamps, and a switch-board is erected by means of which either of the large dynamos can be connected to either of the two night circuits. The lamps are distributed between these two circuits so as to overlap each other, in order that either circuit may form a panic circuit in case of the extinction of the other. The total number of lamps installed considerably exceeds the capacity of the dynamos, but the distributing switches are so arranged that it is impossible to light all the lamps simultaneously. On the stage there are fixed 1,162 lamps, of which 550 can be lighted simultaneously, while 612 lamps serving for red and blue lights can be switched in when the others are extinguished. The large corona in the auditorium contains 124 lamps, and 56 lamps are distributed round the tiers. In addition to these there are 272 10 candle power lamps fixed in the engine house and offices, and two 1,000 candle power arcs in front of the theater.

THE TELEPHONE.

It is reported that all the London telephone companies are to be consolidated.

A press dispatch states that B. S. Whitaker, agent of the telephone company at South Pittsburg, Tenn., has disappeared. With him disappeared a quarter's telephone rents he had collected.

The general offices of the Central Union Telephone company are to be removed to the new telephone building at 203 Washington street, Chicago. Following is a list of the officers and employes with the numbers of their rooms in the new building: Geo. L. Phillips, president, Room 30; W. S. Chapman, secretary and treasurer, Room 43; F. G. Beach, general superintendent, Room 42; A. A. Thomas, general solicitor, Room 40; J. C. Kenny, supply agent, Room 43.

This is the way Daniel Drawbaugh is described by a correspondent who visited him at his home. "A Pennsylvania Dutchman in the heart of Pennsylvania, a little old, pottering experimenter with a heart as fresh and hopeful as a lad's—this is the Daniel Drawbaugh of to-day, a man who has been kicked and pounded by fate in many a bitter contest, but who is still in the ring, as the prize fighters say, and who refuses to be knocked out, no matter how many times he is made to bite the dust."

In speaking of the death of Chief Justice Waite the London *Electrical Review* says: "He had presided on the bench in the Supreme Court on the Monday of the same week during the reading of the opinion of the court in the famous Bell telephone case. This was his last appearance on the bench. It is a remarkable coincidence that the late master of the rolls, Sir George Jessel, died a few days after delivering his opinion in the Bell case in 1882, having sat on the bench for the last time to deliver that opinion."

A telephone, placed in the circuit of a submarine cable through which the ordinary signals are being transmitted, is affected by the currents passing; although the vibrating of the diaphragm may not be perceptible to the ear, for the well known reason that a minimum of twenty vibrations per second is requisite to produce an audible sound, says the London *Electrical Review*. But if an interrupter, breaking the current more than twenty times per second, be also inserted in the circuit, an undulating sound is conveyed to the ear by the telephone. On this principle, M. Ader has constructed an apparatus which allows of the employment of phonetic signals in submarine telegraphy.

In the injunction suit of the Bell Telephone company against the Southern Telephone company which has been on trial in the United States Circuit court at Little Rock, Ark., Judge Brewer last Saturday handed down a decision sustaining the Bell company and granting the restraining order. He held that the recent decision of the Supreme court conclusively determined the question. He decided that the make and break theory advanced by the defendants was untenable, and did not relieve them from infringements, and that the fact that the injunction was not asked for until after the Supreme court's decision did not constitute undue delay in complainants. Counsel for the Bell company filed a bill against the Bay Telephone company for infringement of patent.

Kareis & Bondy, Vienna, have patented iron or steel wires covered with a spiral serving of copper wire or ribbon of very small thickness. These wires are now being tested at the laboratory of the Electrotechnical institute in Vienna, and have so far given fairly good results. The object of the invention is to provide aërial wires having less self-induction and resistance than ordinary iron or steel wires, without sensibly diminishing the mechanical strength. The wire is intended for use with currents of rapid period, such as occur in telephony or in high speed telegraphy, and as through self-induction the flow of current is displaced from the center to the circumference, the inventors argue that it would be useless to make the center of a material having a high conductivity.—*Industries.*

The following experiment in short distance telephony was related by John Butler a prisoner in Columbus, Ohio, charged with burglarizing the post office at Olentangy: He says himself and two other men effected an entrance into the post office, having first provided themselves with a long string having a tin can attached on each end. A tug on the string indicated that the outside operator desired to communicate. The string was at once tightened when the workers on the inside were informed from which direction danger might be expected. In this way the burglary was a complete success, and quite an amount of postage stamps were taken, most of them having been since recovered. The two other men made good their escape.

THE ELECTRIC MOTOR.

A motor plant will be installed at Nashville, Tenn.

The Woonsocket railway company expects soon to have its electric road in successful operation.

The application of an electric motor to coal cutting machinery has been carried out by Messrs. Bower, Blackburn, & Mori, of Woodlesford, England.

Here is another opportunity for motor companies. It is said that the Rock Island railroad will build an elevated railroad at Chicago to accommodate its suburban traffic. It has not been able to operate its suburban trains with any regularity for two years, and this condition grows worse steadily as the road's freight business increases. It has long been a question with the company whether it will increase its facilities by the acquisition of more ground on which to lay tracks, or by the construction of an elevated road. The latter plan has been it is said determined upon.

In an article on the electric railway the Chicago *Tribune* says in speaking of the objections which have been made to this mode of street car propulsion: "It would seem, however, that all these objections have been met successfully in the climate of the United Kingdom, which is uniformly damp, as compared with ours, and therefore more difficult to deal with electrically. In the light of all this it would seem that the managers of projects for cheap transportation in this country might take a lesson profitably from their brethren on the other side of the Atlantic, and perhaps learn from them how to carry the American public on lower terms than any which have been proposed in this country."

Mr. Ransom, writing on the comparative cost of steam, horse, cable, or electricity, takes a sample road, six miles long, with twenty-four cars, a speed of six miles an hour, and running twenty hours out of twenty-four. This would require forty-eight horses on the lines and 192 in the stables, costing, with harness, initially about $38,400. The initial cost for electrical plant he estimates at $26,500, for cable plant $35,000, and for comparison these figures may be put: A motor plant of horses cost $38,400; of electricity, $26,500; of cable apparatus, $35,000. With regard to the road, the estimate is for horse road single track per mile, $9,000; electric varies, according to system, from $10,000 to $23,500; cable roads from $30,000 to $110,000; steam, $9,000. If old roads have to be adapted to the new traction, the cost of adaptation is given for a six mile road: For cable, $265,200; for electricity, $70,500; for steam, $40,000.

THE TELEGRAPH.

The gross revenue of the English telegraph system for the last year was £1,950,000 against £1,830,000 for the preceding year.

The Associated Press will have space for 40 men at the Democratic national convention at St. Louis, and will have large room for telegraph instruments.

At the beginning of the year the charge for sending telegraph messages in Norway was reduced from 30 cents for 15 words, to 15 cents. The increase in the number of telegrams during the month of January at the Christiana exchange was almost 100 per cent.

A decision was handed down by Judge McPherson, at Harrisburg, Pa., last week in the case of the Commonwealth against the Western Union Telegraph company for resettlement of taxes and to recover the amount, based upon the cash dividends during the years from 1876 to 1882. The decision sets forth that the taxes cannot be recovered.

It is no easy matter to keep up the telegraph lines in Mexico. Travelers on the northern plains find the poles excellent fuel for their camp fires. The ranchero who wishes to fence in his territory cuts down a mile or two of wire for the purpose. Added to these trials the poles are subject to the attacks of an industrious worm which honeycombs the wood.

A number of members of the Association of North American railroad superintendents made a trip over the

New Jersey division of the Lehigh Valley road, April 12th, to inspect the working of the induction telegraph system. The value of the system was demonstrated. The engine was disabled and the train operator was obliged to telegraph for another locomotive.

A cable despatch from London announces that "The impression prevails that the British annexation of Fanning, Christman's and Penrhyn islands in the Pacific, indicates that a British survey, which has already been regarded as essential to establish the practicability of a Pacific cable, is about to be undertaken. It is alleged that apart from the commercial value of the cable, the imperial government realizes that it would serve to bring the several British naval stations within touch of each other."

Personal Paragraphs.

F. S. Terry, manager of the Electrical Supply company, has been west on a short trip.

William O. Webber read a paper on "The advantages of and methods for testing engineering materials" at the meeting of the Boston Electric club last Saturday.

H. B. Warren, superintendent of construction for the northwest, of th e United States Electric Lighting company, visited friends in Chicago last week, and the first part of the current week.

The executive committee of the National Association of Gas Engineers has appointed Prof. J. P. Barrett, city electrician of Chicago, to read a paper on the danger of electric wires introduced in buildings for lighting and power, at the annual convention August 14, at Minneapolis.

A. S. Abell, the millionaire owner of the Baltimore *Sun*, died last week. Mr. Abell was personally associated with Prof. Morse in the promotion of the magnetic telegraph. The *Sun* published the first message sent over the wires, then an experiment, between Washington and Baltimore, and also published on May 11, 1848, the first Presidential message ever received in that way. From the starting of the paper, Mr. Abell gave his undivided attention to the pro motion of newspaper enterprise in all its different phases, and his career has been one of the most successful and re markable in the history of journalism in this country. On May 17, 1887, he celebrated the fiftieth annive sary of the establishment of the paper, and took into partnership his three sons. He leaves a fortune of about $20,000,000.

Miscellaneous Notes.

A Kansas City correspondent of a New York paper says it is significant that there is a morgue at the foot of each one of the cable car inclines in that enterprising city.

The Chicago Fire Proof and Insulating company has been incorporated with a capital of $100,000. The incorporators are C. W. E. Patterson, Harrison Gouch, and H. F. Osborn.

The manufacturers of bicycles are taking great interest in the process of electric welding. A delegation of makers recently made a visit to the Thomson-Houston manufactory to witness the process.

William J. Morden, assignee of the Young cable traction tracks, has commenced a suit in the United States Circuit Court against the Chicago City Railway company and C. B. Holmes to recover $150,000 damages for infringement.

The seven story building at 338-342 Dearborn street, Chicago, was burned April 20th. Among the occupants of the building were Giles Bros. & Co., whose manufactory, for anti-magnetic watch shields was on the sixth floor. Their loss which is fully covered by insurance will probably be several thousand dollars.

The Chicago north side cable is no more popular than it was a month ago. Here is the *Daily News* complaint: "Weeks have passed since Baron Yerkes flared up with flags, bands and speeches, and announced that the north side cable was open to the public. Since that premature splurge, the baron's antiquated steeds have been compelled to drag as many north side citizens as before, while the delusive cable has been putting in the time getting off the track, balking at switches, and generally impeding the already sluggish traffic of the streets."

The Western Electric Benevolent association held its second reception at Brand's Hall, Saturday evening, April 7th. The affair was a decided success in every way. About one hundred and sixty couples participated in the grand march, and an excellent programme of eighteen dances was enjoyed by every one present. During the evening Fred. Miller and the Electric Quartette favored the audience with a few choice vocal selections, each of which was followed by several encores. May 1st the association will close the first year of a very successful career with eighty-five members, and a good round sum in the treasury, notwithstanding the fact, that during the past six months they have paid for benevolent purposes over seven hundred dollars.

A Meriden clothing dealer recently offered a spring overcoat to any person solving the "anti-rattle-box" puzzle. This consisted of a short cylindrical wooden box, securely sealed. The point was to shake the box without rattling the contents. On the box was printed: "You can't do it; but it can be done." Those who got hold of the boxes, after shaking them in different ways, cut them open and found the contents to consist of pieces of tin of different shapes. As no method of doing the trick could be thought of, it was generally supposed that the puzzle could not be solved. Charles M. Fairchild, assistant to Superintendent Fitzgerald, of the Meriden Electric Light company, came into possession of one of the boxes. He dissected it, noticed the bits of tin, thought a moment, and then, taking a magnet replaced the cover on the box and applied the magnet to one end. It was strong enough to attract all the small pieces of tin and hold them fast to the end of the box however violently it was shaken. He got the overcoat. —*Hartford Times.*

Business Mention.

Forèe Bain, of 76 Market street, Chicago, is doing quite a business in the line of dynamos for electro-plating.

The Peninsular Electric company of Grand Rapids, Mich., has recently issued a new catalogue covering electrical supplies of all kinds.

The Railway Supply company has moved into its new place of business at 54 and 56 Franklin street, Chicago. The new quarters are commodious, and will give Manager Knapp increased facilities for transacting his growing business.

W. H. McKinlock, of the Central Electric company, Chicago, returned from a business trip of one week's duration recently and among the orders he brought back was one for fourteen miles of Candee wire for electric light purposes. The sale of this wire is increasing in proportion as its merits become known.

The Waterhouse Electric & Mfg. Co., have secured the contract for the electric light plant for the central station of the Joliet Electric Light company at Joliet, Ill., to super sede other systems heretofore in use there. The price paid for a 100 full arc light plant exclusive of steam plant or circuits, was $10,000. The Joliet company selected this system after a careful investigation, as in their opinion the best of any for efficiency, and economy for commercial lightning.

The Central Electric company of 38 and 40 La Salle street, Chicago, have leased from the first of May the four-story building and basement at 42 La Salle. The fact that this company, not yet a year of age, has been compelled to seek quarters having an area about five times greater than those in which they began business not twelve months ago speaks more loudly for their enterprise and good business management than words could.

Very long runs made by steam engines are considered rare, and long runs have heretofore been considered several days, or a few weeks. The Westinghouse engine has increased this time in many instances to a number of months. The last public notice of a long run made by Westinghouse engine was a notable instance where a certain engine ran eleven months without stopping, at a speed of 300 revolutions. The most remarkable record, however, has recently developed in the Pittsburgh Gas Light company, where a ten-horse power Westinghouse engine ran continuously for thirteen months, running at about 500 revolutions per minute, and in that time making 288,000,000 revolutions without the throttle valve being shut, and it is still running. It seems to take Burgess to beat Burgess.

The volt and ammeters made by the Waterhouse Electric & Manufacturing company are constructed on the principle of electro-magnetic repulsion, which is a constant with equal current. Heretofore these instruments have been made to act by means of a permanent magnet, or in their construction a coil spring has been used, so that the magnetism of the magnet, or the reslience of the spring has been a varying quantity, and frequent calibration has been necessary to correct these variations. The Waterhouse instruments are calibrated by the Cornell University standard, and once adjusted remain in adjustment. An ammeter may be left in the circuit with the current continually passing through it, but its adjustment is unchanged. The instruments are very sensitive to variations of the current transmitted through them, and are not only adapted to electric light stations, but also for the finest laboratory tests. The company also make a very fine galvanometer and other delicate instruments.

Electrical Patents.

Issued April 17, 1888.

381,167. Reflector for Electric Lamps. Hiram Purdy, Burlington, Iowa.

381,220. Static Compensator for Telegraphs. Minor M. Davis, Brooklyn, N. Y.

381,222. Electric Motor. Philip Diehl, Elizabeth, N. J.

381,228. Means for Regulating and Controlling Electric Motors. Bradley A. Fiske, U. S. Navy.

"Claim 5. The combination of an electric motor, means for regulating its speed or direction, or both, and two sets of contact devices, variations in whose relative position affect said regulating means to vary the speed or direction of the motor, one set of contact devices being arranged to be continuously rotated by the motor and the other to be continuously rotated by hand."

381,234. Telephone Transmitter. John M. Graham, Pittsburgh, Pa.

381,246. Telegraphy. Zeroy P. Hotchkiss, Oak Park, Ill.

381,251. Dynamo Telegraphy. Francis W. Jones, New York, N. Y.

The claim is given. "The combination, with a transmitting device having two sets of front and back contacts, of two sources of electricity of substantially the same tension, but opposite polarity, whose connections with the circuit are governed, respectively, by one set of contacts, two other sources of current, also of opposite polarity, but of different tension from the first, similarly governed by the second set of contacts, and a second back and front contact transmitter that in its normal position closes the connection for one set of contacts of the first transmitter, and when depressed breaks such connection and closes the connection for the other set."

381,254. Regulator for Electric Currents. Edward R. Knowles, Brooklyn, N. Y.

381,260. Electro-Magnetic Spectacles. John T. Leighton, Edinburgh, County of Edinburgh, Scotland.

381,269. Electric Contact Changer. Preston C. Morse, Natick, Mass.

381,271. Slate for Telephone Desks. Emil T. Mueller, La Crosse, Wis.

381,279. Electrical Registering Device. Samuel M. Pruden, Newark, N. J.

381,303. Electric Switch Board. Richard H. Welden, Chicago, Ill.

381,304. Electrical Coil and Conductor. Edward Weston, Newark, N. J.

One half of the core is wound with a conductor made of an alloy containing about 65 parts of copper, 35 of ferro-manganese and from 2 to 10 parts of nickel. The resistance of this conductor diminishes as it becomes heated, while that of the German silver or copper conductor wound on the other section of the core increases with heat. Thus by using both on the same core a balance in resistance is secured.

We give the second claim. "A conductor consisting of two metallic portions, one of which is composed of a material the electrical resistance of which increases with an increase in its temperature, and the other is composed of an alloy of copper, manganese or its equivalent, and nickel."

381,305. Electrical Coil and Conductor. Edward Weston, Newark, N. J.

The conductor is composed of about seventy parts of copper, with thirty parts of ferro-manganese, this alloy is capable of being rolled and drawn and made into wire the usual way.

The claims are given. "1. A coil or conductor wound in convolutions composed of an alloy of manganese and copper or its equivalent.

"2. A coil or conductor wound in convolutions composed of copper and ferro-manganese, in the proportions of seventy parts of copper and thirty parts of ferro-manganese.

"3. A rheostat, resistance, or other electrical instrument of the kind herein described, the coils or conductors of which are composed of an alloy of copper and manganese or its equivalent."

381,314. Electric Bell. Frank B. Wood, New York, N. Y.

381,336. Galvanic Battery. Charles R. B. Claflin, Jr., and Joseph W. Flagg, Worcester, Mass.

381,343. Electric Train Signaling Apparatus. John R. De Mier, Las Cruces, N. Mex.

381,344. Electric Train Signaling Apparatus. John R. De Mier, Las Cruces, N. Mex.

381,372. Apparatus for Electrolysis. Eugene Hermite and Charles F. Cooper, Pownall Road, Dalston, County of Middlesex, England.

381,382. Telephone Transmitter. Edward H. Johnson, New York, N. Y.

A piston takes the place of a diaphragm. The inlosing cylinder of the instrument is closed at one end —that opposite the mouth piece—and the piston is made to fit quite accurately the walls of this inclosing cylinder or internal support, or both. The effect of this construction is to form an air cushion preventing abnormal movements of the piston.

We give claim. "In a telephone transmitter, the combination, with a sound receiving body and a stationary electrode, of a movable electrode and a magnet armature, both carried by said sound receiving body, and an electro-magnet which is brought into action by a movement tending to separate the electrodes, and then attracts said armature in the direction to draw the electrodes together."

381,394. Commutator Brush for Electric Generators. Osborn P. Loomis, Somerville, Mass.

The invention consists in a collecting-brush, composed of sheet copper strips, which has metal pieces at one end, to which the strips are soldered, and bearing at its other end upon the commutator, the strips being arranged diagonally to the plane of the brush.

The fifth and sixth claims are given. "5. A commutator brush composed of metal strips diagonally arranged to the plane of said brush, substantially as described.

"6. A commutator brush composed of strips diagonally arranged to the plane of said brush, and having the axis of the brush arranged substantially at right angles to the axis of the commutator."

381,395. Electrical Railway. John C. Love, Philadelphia, Pa.

381,396. Railway Cars. John C. Love and James F. Snediker, Philadelphia, Pa.

381,398. Dynamo-Electric Machines. Richard H. Mather, Windsor, Conn.

Claim. "3. In a shunt wound dynamo electric machine, two pole piece helices, one of which is wound in the same direction as the field magnet and the other of which is wound in the opposite direction."

381,420. Reactive Coil. E. Wilbur Rice, Jr., Lynn, Mass.

The invention relates to sectional electric coils, such as induction coils, reactive coils, or other forms of magnet coil when used with alternating electric currents; and the invention consists, more particularly, in the switch employed for varying the power of such a coil by varying the number of sections of coil in action.

Claims one and three are given. "1. The combination, with a variable or adjustable sectional electro-magnetic coil placed in an alternating magnetic field, of an electric switch and an artificial resistance or reactive coil, as described, in the connection between the terminals of the coil section when the switch is connected with both coil terminals at the same time.

"3. The combination, with an induction coil having a sectional wound set of coils, of an electric switch for varying the length of wire in a set to vary the potential at the terminals of the secondary, and a reactive coil, connected with the switch and included successively in multiple with the coil sections as the switch is moved for varying the number of coils in circuit."

381,421. Dynamo Electric Generator. Elias E. Ries, Baltimore, Md.

Claim. "1. In a dynamo electric machine, the

combination, with a main exterior field magnet system of two ring armatures arranged facing each other between the polar extensions thereof and an auxiliary field magnet secured to and supported by the exterior pole pieces and extending between and into the interior of both armatures, substantially as described."

381,422. Electrical Indicator. Andrew L. Riker. New York, N. Y.

381,430 Circuit for Double-Stranded Telephone Switch Board Cords. Charles E. Scribner. Chicago, Ill.

The invention consists in providing a metallic heel for each of the loop plugs of the different pairs and a metallic plate for each pair, upon which said heels normally rest in contact. This metallic plate is permanently connected to the strand of the pair of cords with which the sleeves of the plugs of the pairs are connected. In this manner a circuit is provided from one strand of the cord to the other, which will be closed when either plug is inserted in a spring jack for the purpose of answering the call of the subscriber.

Claim three is given. "3. In a telephone exchange switch board apparatus, a pair of loop plugs and their pair of double-stranded cords, one strand including the telephone and the other strand being connected with a metallic connection, with which the heel-piece of either of the plugs may be connected, in combination with the two terminals of a spring-jack, in which either of the plugs may be inserted, whereby the two terminals of the spring-jack may be connected together through the different strands."

381,431. Long Distance Connection for Multiple Switch Boards. Charles E. Scribner. Chicago, Ill.

The invention is designed to provide facilities for connecting any of the lines of a local telephone exchange whether single circuits or metallic circuits, with the long distance telephone lines which are necessarily metallic circuits. In multiple systems the long distance connections are made by themselves in a room apart from the room containing the local switch-boards.

The invention relates especially to making the connections between the local lines and the long distance room.

381,440. Machine for Lighting and Extinguishing Gas. George E. Thaxter, Boston, Mass.

381,441. Electric meter. Elihu Thomson, Lynn, Mass.

The invention consists in producing motion by the use of a balance carrying a receptacle consisting of two bulbs connected by a tubular arm. The receptacle is partly filled with vapor produced by electricity—a volatile liquid. By pressure over the liquid in one bulb the liquid is forced through the connecting tube into the other bulb thus destroying the balance and causing the heavier side to fall while the other rises. By alternating the electric current a continuous movement is produced which is employed to actuate an indicator. Claim 3 is given:

"3. In an electric meter, a suspended or oscillatory structure, consisting of two or more receptacles connected together at their lower portions by a narrow tube or set of narrow passages and containing alcohol or other vaporizable fluid, a resistance or heating coil for each receptacle, and switch devices whereby upon each oscillation an alternation of electric connection from one heating coil to the other is made, substantially, as described."

381,442. Electro-Mechanical device. Elihu Thomson, Lynn, Mass

The invention relates to a form of apparatus wherein the evaporation of a liquid gives rise to a vapor which is held in a confined space and the tension of which acts to impart a movement to some device, preferably to the body of liquid from which the vapor is evolved. The movement of the liquid itself may be the ultimate movement desired, or may give rise to other movements, which may be utilized in several ways.

We give the first and last claim:

"Claim 1. The combination of a closed receptacle partly filled with volatile liquid, a heating conductor giving rise to a bodily movement of said liquid, and a register for indicating the amount of said movement.

"19. A pivoted receptacle in unstable equilibrium, consisting of two closed chambers or bulbs communicating below and partly filled with volatile liquid, heating conductors applied to said chambers or bulbs giving rise to oscillatory movements of said receptacle at definite periods, and a register for indicating the movement of said receptacle."

381,443. Electric Meter. Elihu Thomson, Lynn, Mass.

The invention relates to apparatus which may be employed either for the purpose of measuring electric currents or as a source of light motive power. We give the first and last claims:

"Claim.—1. The combination, with two confined bodies of fluid contained in separate chambers, of a shiftable pivoted or tilting weight controlled in its position by the expansions of said fluid, electric heaters for expanding the same, and switches controlled by the movements of the shiftable weight for shifting the electric current to the heaters alternately, as and for the purpose described."

"7. The combination, with two confined bodies of fluid contained in chambers forming a pivoted or tilting structure, of a shiftable weight moved by the expansive force of said fluid, electric heaters for causing expansion of the fluid, and switches controlled by the movements of the tilting structure for shifting the electric current, as and for the purpose described."

381,446. Switch Circuit-Breaker, etc. John Von Der Kammer, Newark, N. J.

381,451. Dynamo Electric Machine. Jonas Weström, Orebro, Sweden.

"Claim.—1. In a dynamo electric machine, the combination, with the magnetizing coils located in annular spaces between the iron cores and iron casing cylinders, of the iron cases provided with air circulating apertures leading from the interior through to the outer periphery of the machine."

381,459. Electric Valve Controller for Automatic Fire Extinguisher. Thomas Atkinson, Richmond, Va.

381,480. Electric Meter. Samuel D. Mott, N. Y.

381,492. Electric Elevator. George C. Blickensderfer and John K. Hallock, Erie, Pa.

The second and last claims are appended:

"2. The combination of a fixed screw shaft or column, a revolving nut or gear in engagement with said shaft and affixed to an electric motor armature shaft, a car or cage supported by said armature shaft, field magnets for said armature located upon said cage, circuit connections for said motor, and devices for reversing the direction of rotation of the armature shaft and revolving nut.

"18. The combination of an elevator car having an actuating or propelling electric motor, brushes for the commutator of the motor, a dial or indicator, and gearing interposed between said indicator and brushes."

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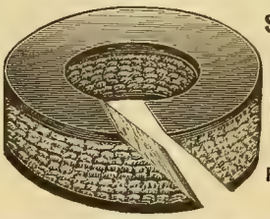

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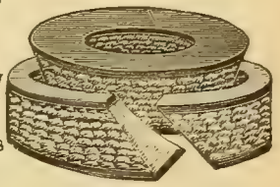

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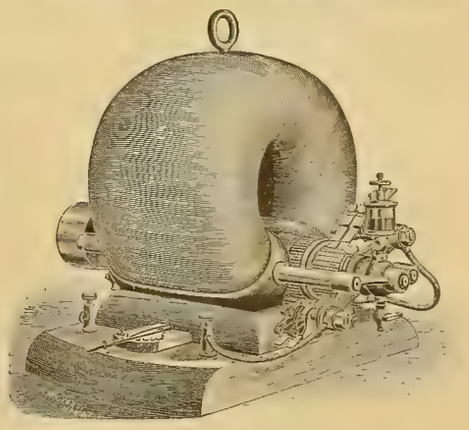

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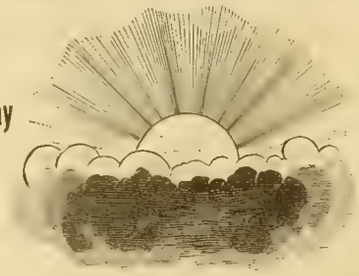

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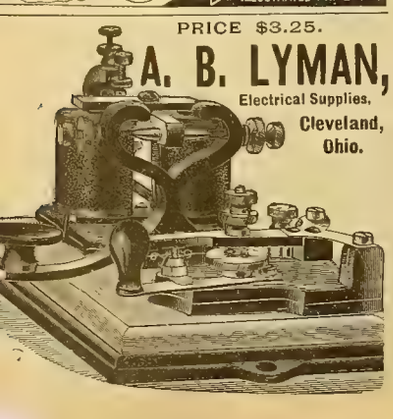

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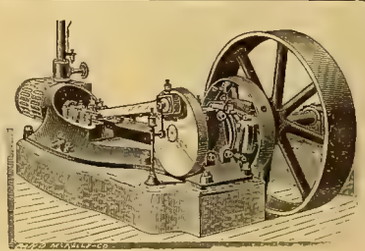

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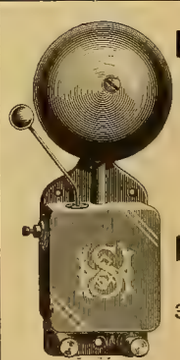

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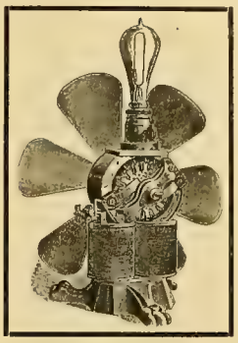

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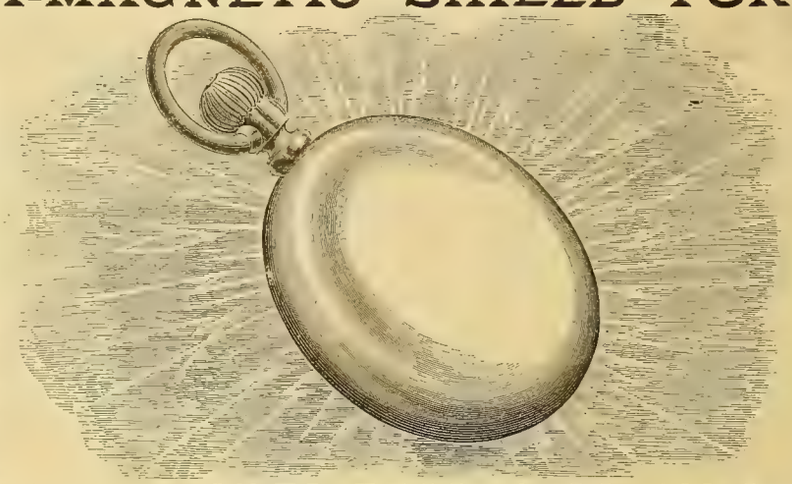

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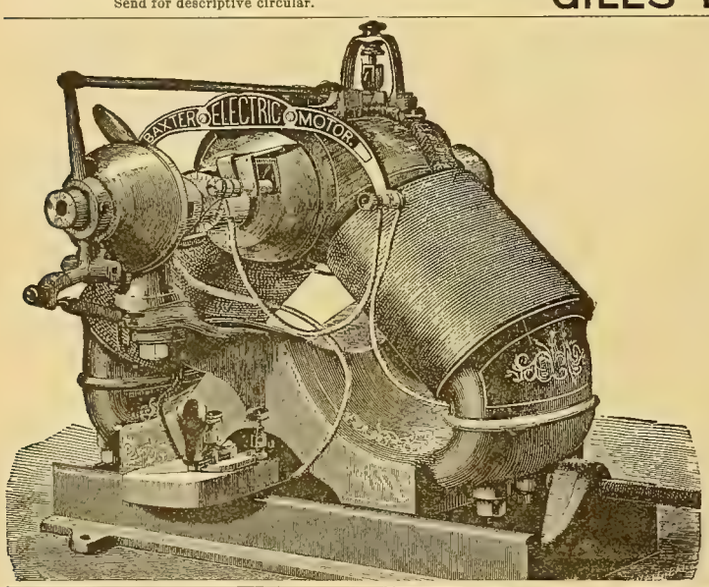

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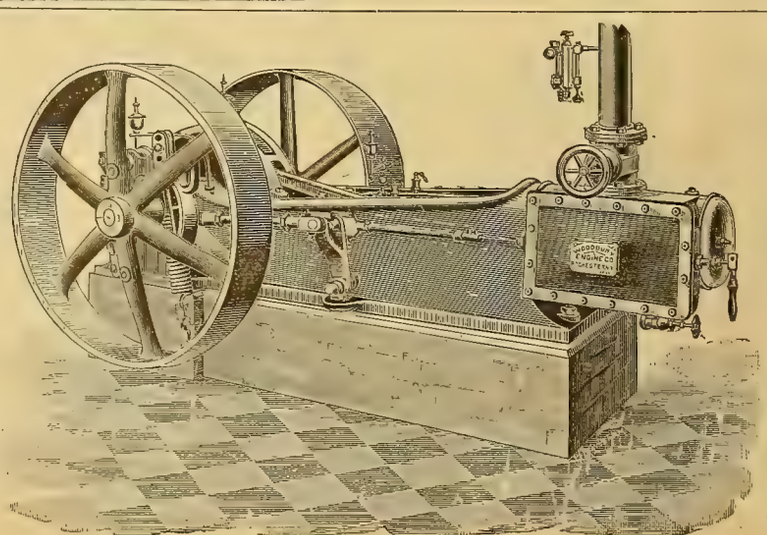

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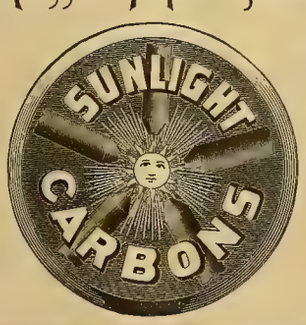

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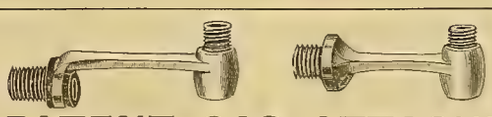

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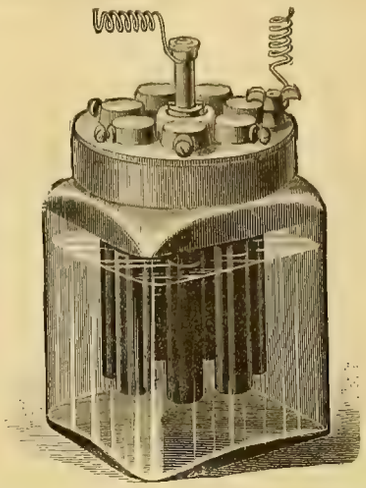
BEST AND  CHEAPEST!

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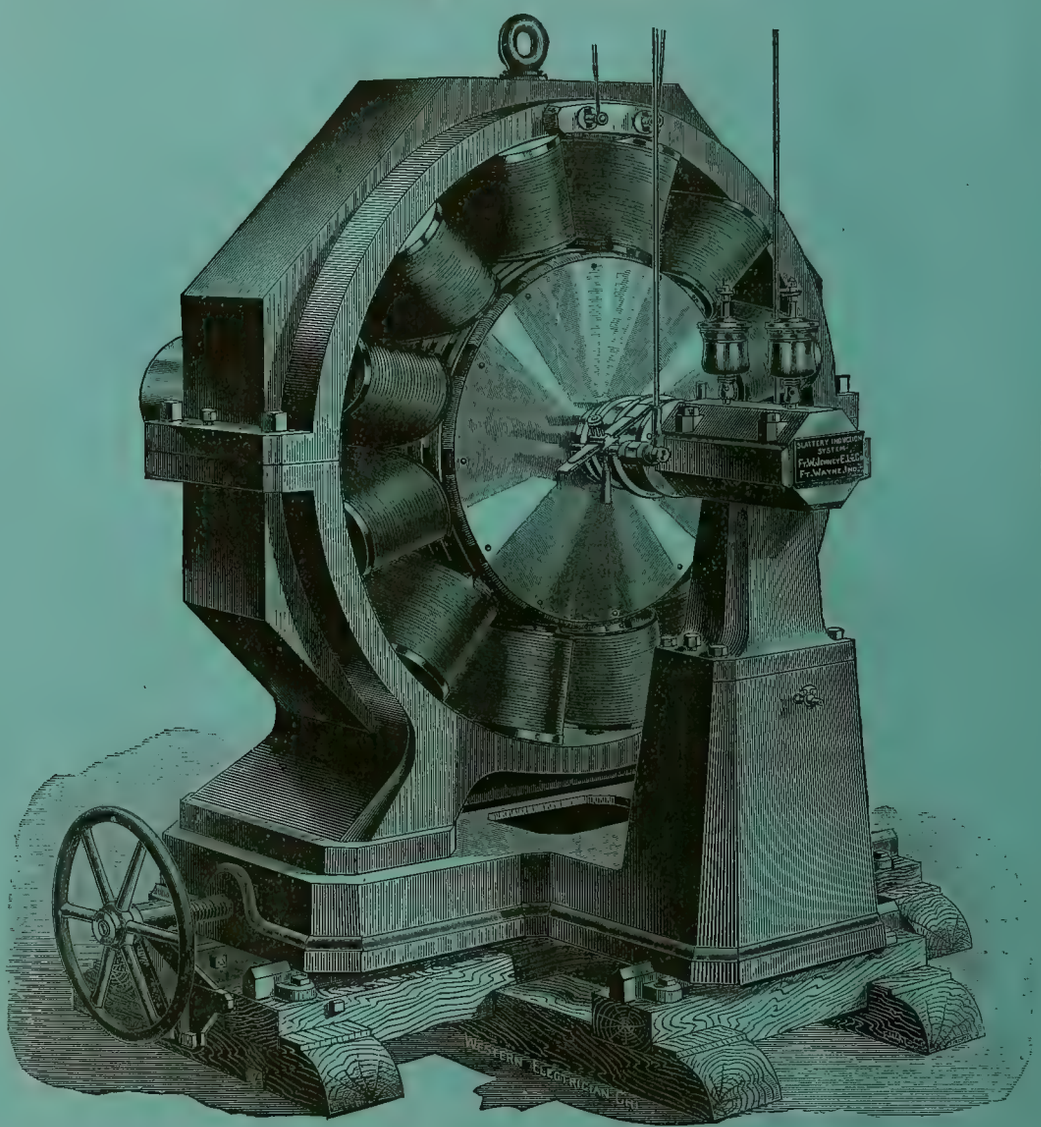

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CITY OF MEXICO OFFICE MEXICO, F. Adam, Successor.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. II. CHICAGO, MAY 5, 1888. No. 18.

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THE UNITED ELECTRIC COMPANY,

SALT LAKE CITY, UTAH.

DEALERS IN

ELECTRICAL APPARATUS AND SUPPLIES,

Hotel and House Annunciators, Electric Gas Lighting, Fire and Burglar Alarms, Electro-Medical Apparatus, Telegraph Instruments, Wire and Batteries.

ESTIMATES FOR ELECTRIC LIGHTING GIVEN ON APPLICATION.

THE ONE PIECE MALLEABLE

Cable Hanger.

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Easily and Quickly applied by Special Tongs.
Will not Abrade Cable.
THE CHEAPEST AND BEST IN THE MARKET.

STANDARD UNDERGROUND CABLE CO.,
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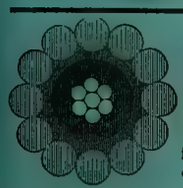

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power. Telegraph and Telephone, Railway and all other Branches of Signaling. Aerial Use, All Sizes Subterranean Use, Submarine Use *Lead Encased Wires.* Concealed Wiring in all Locations.

CLARK B. HOTCHKISS, Gen'l Mgr., - 16 Dey St., NEW YORK.

Electric Leather Belting.

SPECIALLY Adapted for use on DYNAMOS.

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WIRE SCREWED! Guaranteed to Give Satisfaction.

MANUFACTURED BY

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Grimshaw Splicing Compound,

A Perfect Insulator, and the only Compound that will make a perfectly

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BITITE and TRINIDAD

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ELECTRIC LIGHT WIRES of all sizes a SPECIALTY

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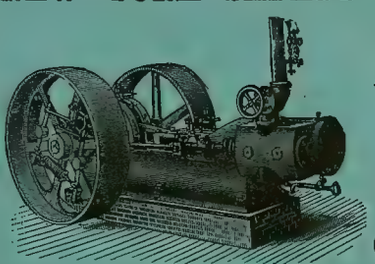

Builders of High Grade Self-Contained

Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

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And other duty requiring close regulation of speed.

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Fire-Proof and Weather-Proof

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CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, Weather-Proof Composition.

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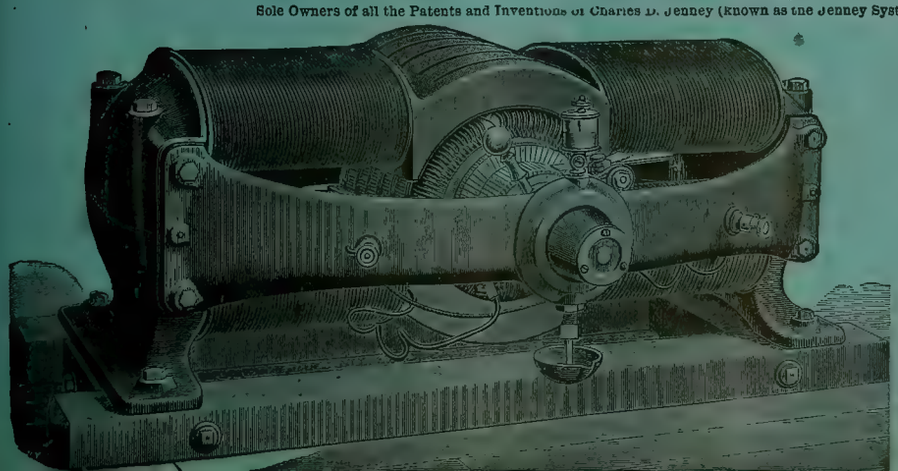
JENNEY ELECTRIC COMPANY.

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (Known as the Jenney System) and Sole Owners and Manufacturers of his



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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

Prices Furnished for the Jenney Arc or Incandescent Systems, or for both combined.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

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SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

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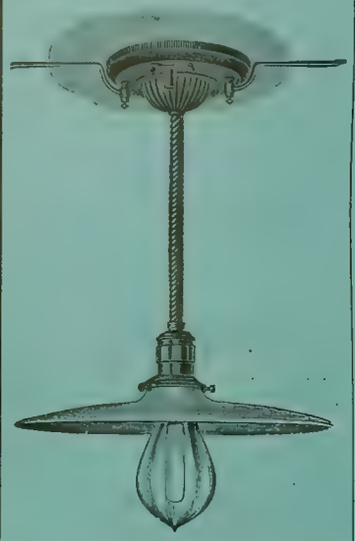

SERIES LAMPS

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Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
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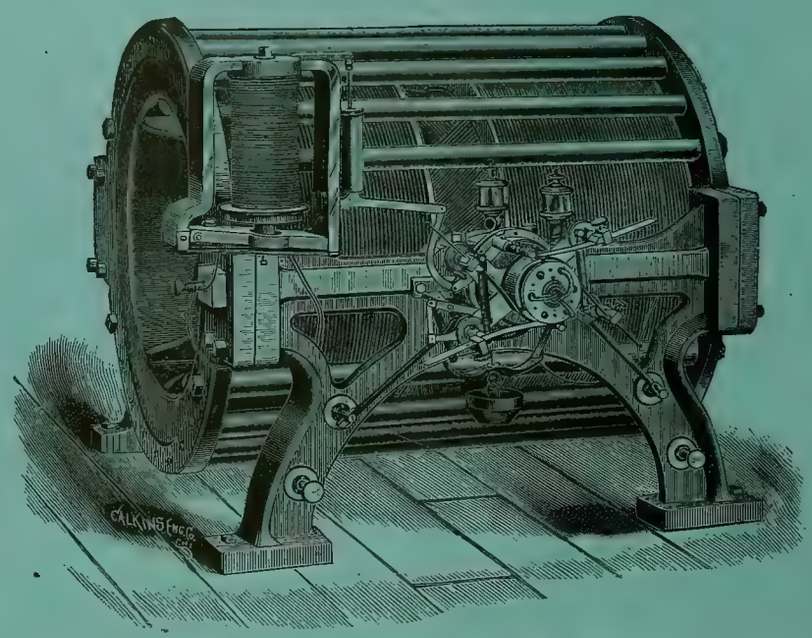
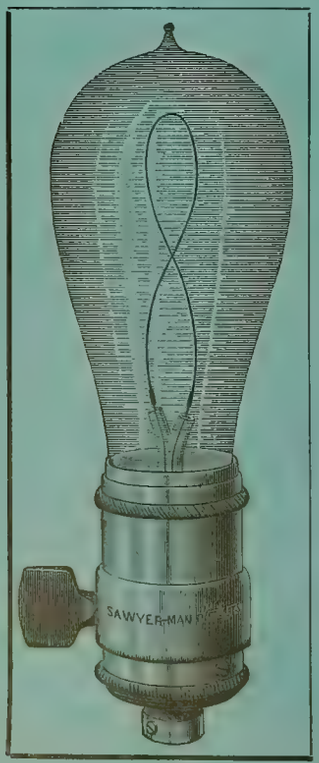


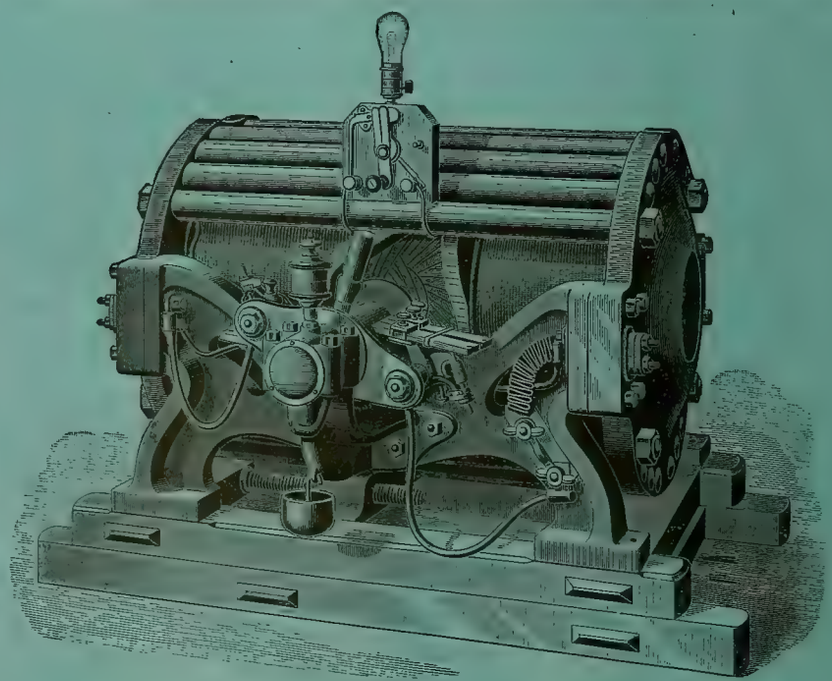
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

Chicago & Northwestern R. R.

Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.
G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

LEONARD & IZARD, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(SIGNED) G. H. THAYER, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

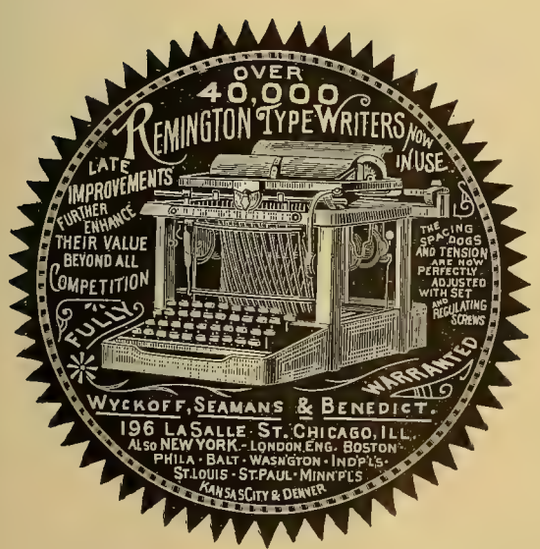
AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{60}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN Manager. **219 LA SALLE ST., CHICAGO.**



The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,

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MANUFACTURERS OF

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Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

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Plans and Estimates Furnished for all kinds of Incandescent Lighting.

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

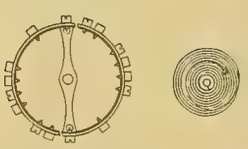
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**

These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

FOR SALE BY ALL FIRST-CLASS JEWELERS.

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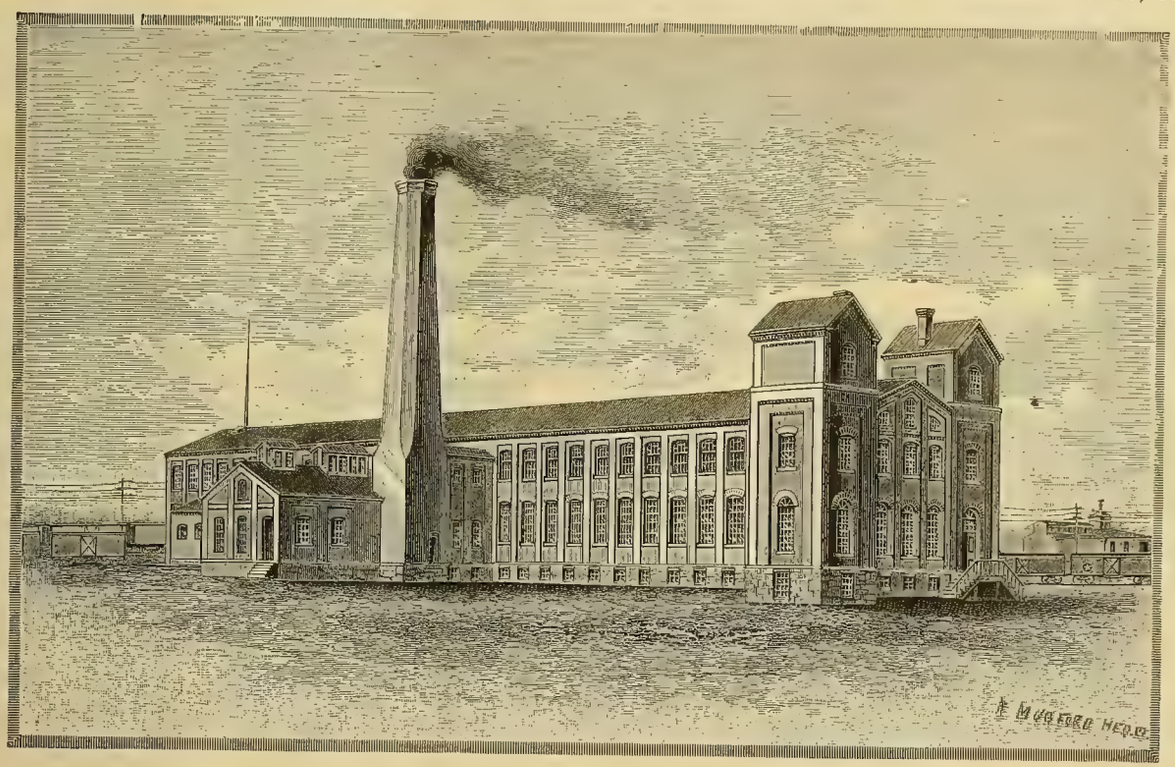
PRECISION.

We make instruments for Electrical Measurements, adjusted to any degree of precision required for any purpose. Resistance boxes are made with any required series of resistances, with and without proportional coils for bridge. All resistances are adjusted to legal ohms by standards tested at the Cavendish Laboratory and certified by the British Association Committee.



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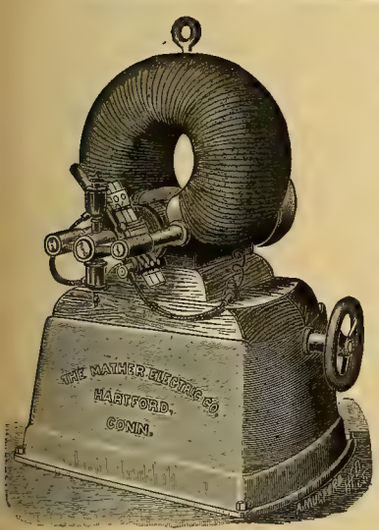
required for physical research, all the coils will be made from one piece of wire, to insure a uniform temperature coefficient. Galvanometers are made of high and low resistance, aperiodic and astatic, or not, as required. Tangent Galvanometers of any capacity will be made to order. Ammeters, Voltmeters and Resistance Coils will be calibrated, and constants furnished.

The Mather System for Incandescent Lighting.



The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

DO NOT BLACKEN IN USE.

Our Dynamo is very simple in construction, runs without spark at the commutators and can be operated by any one accustomed to the care of engines or machinery. The system has no equal for mills, machine shops, or other places requiring isolated plants. We shall be pleased to furnish estimates for complete installations, with or without motive power, and will send one of our experts to examine the premises, if necessary.

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We furnish motors from one-half horse power upwards, for constant potential circuits, perfectly self-regulating without special regulating mechanism. Motors are also furnished for constant current circuits.

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The Tucker Electrical Manufacturing Co.,

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Selling Agents of the MATHER ELECTRIC COMPANY for the States of New York, New Jersey and Pennsylvania.

AMERICAN SYSTEM

OF

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(WOOD'S PATENTS), Owned and Manufactured by the

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18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

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211 AND 213 RANDOLPH ST., CHICAGO,

Manufacturers of and Dealers in

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WE CARRY A FULL STOCK OF J. H. BUNNELL & CO.'S TELEGRAPH INSTRUMENTS.

Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

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B. W. PAYNE & SONS, MANUFACTURERS, ELMIRA, NEW YORK.

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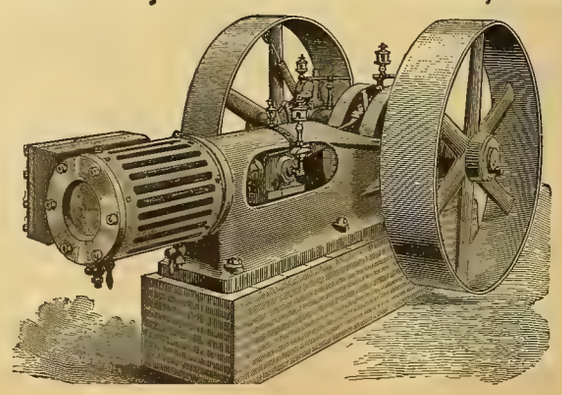
Single Valve and Corliss Valve

ENGINES.

SELF CONTAINED AND SINGLE CRANK

ENGINES

Specially Adapted for Electric Lighting.



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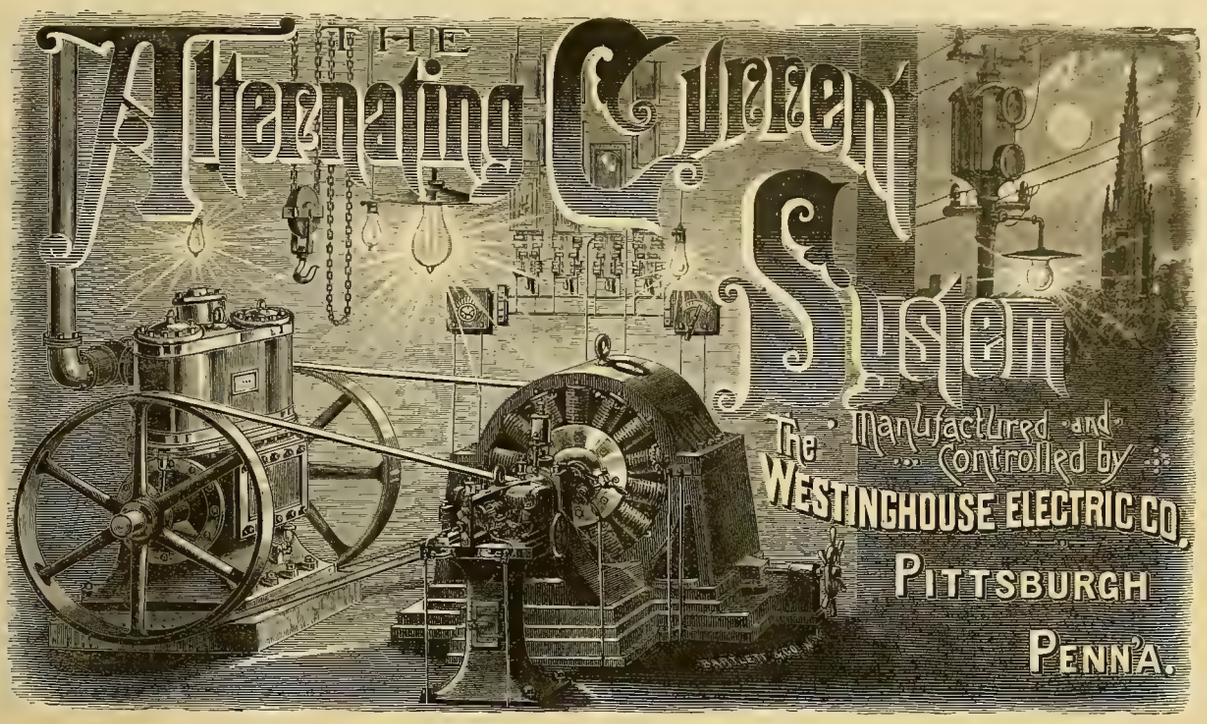
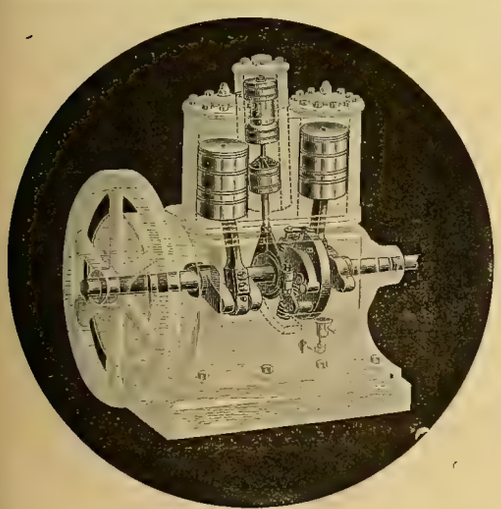
H. S. WALKER, MANAGER.

TELEPHONE 4024.





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SHAFTING { Costs to Purchase / Costs to Maintain / Costs to Lubricate / Costs to Drive } VERSUS THE Westinghouse ENGINE.

Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

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Pittsburgh, Pa.

THE AULTMAN & TAYLOR CO.,
Represented by ROBERTO BOKER & Co., City of Mexico, Mex.

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With houses in Panama, C. A., Lima, Buenos Ayres, Guayaquil and Valparaiso, S. A.

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ELECTRICAL SUPPLIES

For the Telegraph, Telephone and Electric Light.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learner's Instruments, Medical Batteries, Linemen's Tools, Bell Hangers' Supplies, Railway Velocipedes, Cars, Etc.

WESTERN AGENTS THE OKONITE CO., and the Return Call System of Hotel Annunciators. Fire Alarms for Cities and Towns. We own the Franchises of the Western States and Territories for the

IMPROVED McCULLOH
→*AMERICAN + DISTRICT + TELEGRAPH + SYSTEM,*←

and are prepared to give franchises and construct plants on reasonable terms.

☞ Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

The Empire City Electric Co.

15 DEY STREET,

NEW YORK,

Manufacturers and Dealers

IN ALL KINDS OF

ELECTRICAL SUPPLIES.

THE BEST BATTERY

FOR

Telephone and Bell Work

IS THAT WHICH

KEEPS UP TO ITS WORK LONGEST WITH LEAST EXPENSE.

Many new forms of battery have had their brief day since the almost universal adoption of the LeCLANCHÉ. None of them have the record of the LeCLANCHÉ, and it is safe to predict that none of them ever will have, so long as they fail to include the essential features of the **DISQUE LeCLANCHÉ BATTERY,** *which gives it the ability to recover its strength after long and severe use.*

We do not think any Battery except the LeCLANCHÉ, or any LeCLANCHÉ Battery except that of our manufacture, can show such a record as the following:

Western Electric Co., Chicago, Ill., April 10, 1888.
Chicago, Ill.

Gentlemen: Replying to your inquiry of this date, I would say, I have kept a record of the service we get from many of the Disque LeClanche porous cups furnished the Chicago Telephone Company by you since September, 1884. Without going into the minutiæ of this record I will state that it shows that we have had batteries in use which have been in CONSTANT SERVICE for about THREE YEARS and EIGHT MONTHS, and that the AVERAGE SERVICE which we get from porous cups of your manufacture is OVER ONE YEAR and SIX MONTHS.

Our inspectors are instructed to replace porous cups as soon as they show signs of failure, and many of the porous cups brought in as having been used up are still in fairly good condition and would give good service in places which do not require the work from a battery which telephone service requires.

Yours very truly,

J. J. NATE,

Purchasing Agent Chicago Telephone Co.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK LONDON ANTWERP.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, MAY 5, 1888. No. 18.

Chicago Arc Light & Power Company Central Station.

In No. 10, Vol. I, of the WESTERN ELECTRICIAN a brief description of the central station of the Chicago Arc Light & Power company at the corner of Washington and Market streets was given. At that time the work of consolidating the nine independent stations, which had been acquired by purchase by the company, was under way. During the winter the work of installation has gone steadily forward and has reached a point where the artist has been able to step in and record for the benefit of readers of this paper some of the more interesting features of this notable plant.

The main central station, together with the other smaller stations owned by the same company, is now supplying about 1,500 arc lights and therefore the company can lay claim to being among the leading companies in America or Europe with respect to the number of arc lights supplied.

The main station of the company at the corner of Washington and Market streets, occupies the larger part of the basement of the Central Manufacturing block and the larger part of the third floor. The basement is devoted to the steam plant and the third floor to the general offices of the company, the dynamo, testing, repair and stock rooms. The offices are at the north-west corner of the floor, facing on Washington street and the river and in the rear is the dynamo room overlooking the river on the west and a court on the east. The location of the dynamo room in this particular place was well considered, inasmuch as there is an almost perfect freedom from dust in the room. In the rear of the dynamo room is another room which temporarily is being used as a dynamo room and in close proximity are the repair and stock rooms. But arrangements have been made so that the whole floor can be quickly and readily converted into a vast dynamo room if the increasing business of the company demands it.

Fig. 1 is a view in perspective of part of the main dynamo room. It shows six Thomson Houston dynamos in the foreground, the shaft, from which the dynamos are belted supported by pedestals on the floor in the rear and in the background the immense switchboard and other dynamos belting from the same shaft. It will be noticed that the majority of the insulated wires running to and from the switchboard are supported at some distance from the ceiling. Originally they were strung along the ceiling but the deposit of dust by the magnetic whirls about the wires gave an unsightly appearance and consequently most of the wires have been dropped a foot or more from the ceiling. This work has not yet been entirely completed.

The arrangement of the dynamo room will be better understood by reference to Fig. 2 which shows the ground plan. The view for Fig. 1 was taken from the point marked *X* and there seemingly is a discrepancy in the arrangement of dynamos, as two Ball dynamos would appear in the foreground in Fig. 1. However, the view for Fig 1 and the drawing for Fig. 2 were made at an interval of a few days and the first Thomson-Houston dynamo shown in Fig. 1 occupies that position at the present time. An inventory of the dynamos owned by the company is as follows: 26 Thomson-Houston, 13 Ball, 11 Western Electric, 6 Sperry and 4 American, a total of 60. Of this number 35 are shown in Fig. 2 divided as follows: Thomson-Houston 10 machines of 50 lights capacity each, 5 of 45 and 2 of 20 lights; Ball machines 12 of 20 lights capacity each; Western Electric 2 of 35 lights and 3 of 25 lights; Sperry 1 of 25 lights.

The switch-board built by the Western Electric company to order for this station is one of the largest, most commodious and complete ever made. It is shown in Fig. 3. All the circuits in the dynamo room run to the switch-board and they are numbered from 1 to 24 and from 36 to 47, the numbers between 24 and 36 being given to circuits from stations in other parts of the city. The board has a capacity of 48 circuits, no metallic parts are exposed and the switch-board tender in cutting circuits, in or out cannot by any possibility receive a shock. The telephone shown at the left side of the board is for night use. In addition to this telephone there is a large vibrating gong which calls the attention of the chief dynamo man at night to the telephone

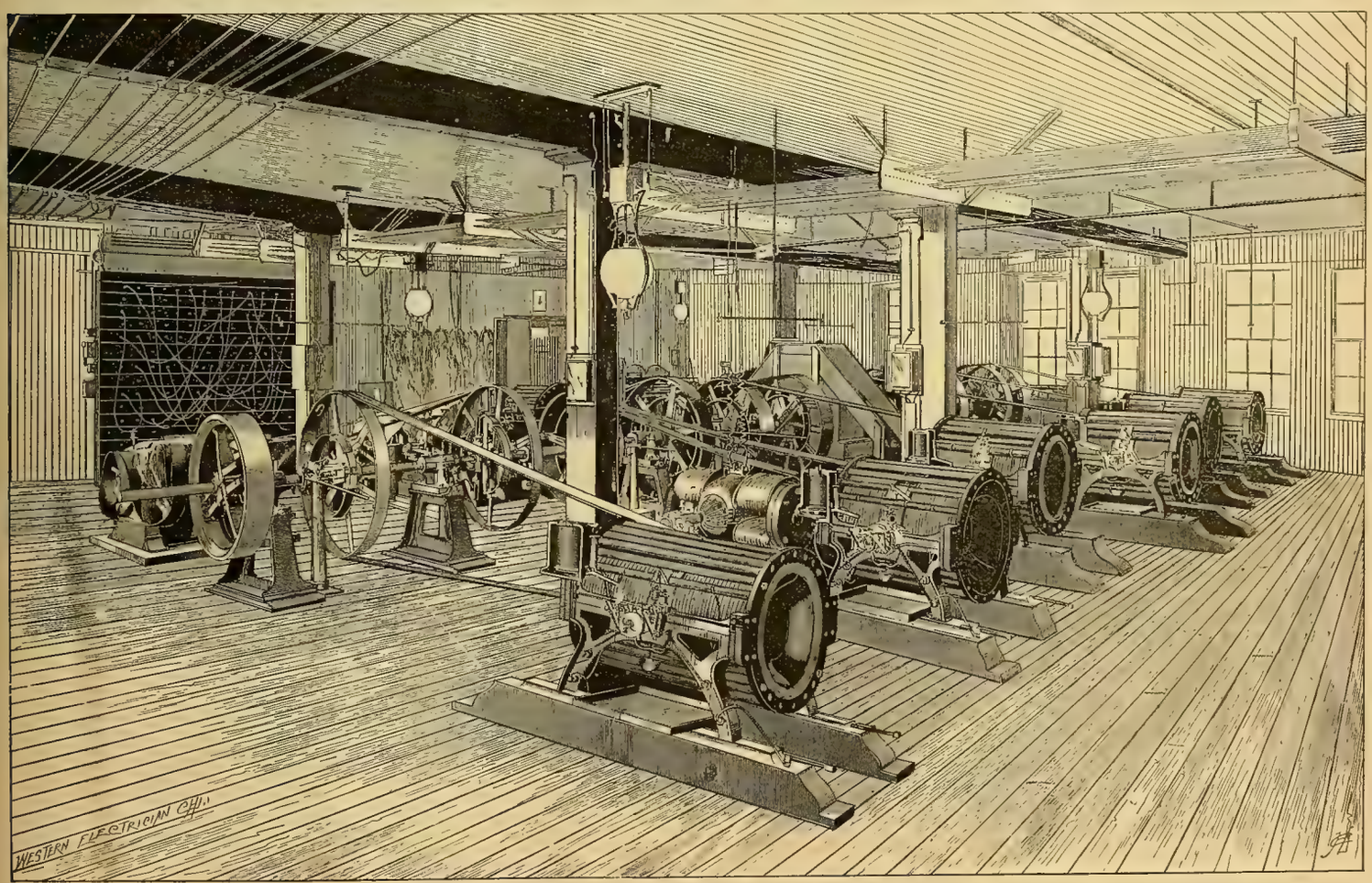


FIG. 1.—DYNAMO ROOM OF THE CHICAGO ARC LIGHT & POWER CO.

in case he is in a distant part of the room. The gong is supplementary to the telephone and can be heard above the noise of the dynamos.

All the circuits from this station are underground. They are in Patterson and Standard Underground cables and are laid in Dorsett conduits. In all there are about 100 miles of underground circuits.

Referring again to Fig. 2, at the right is shown the general plan of the engine room. These engines are located in the basement and transmit their power to the shafts *a* and *a*¹ in the dynamo room by the Dodge system of rope transmission. The engines are Williams compound condensing 500 horse power engines. They were fully described and illustrated in No. 14, Vol. II, page 170, of the WESTERN ELECTRICIAN. Two of the engines are placed but the third is not yet in position. The design of the arrangement is readily comprehended. Engine number 1, for instance, by the use of friction clutches can be made to drive either or both shafts to which the dynamos are belted. The same holds good for either of the other engines, but ordinarily engine number 1 will drive the dynamos at night, engine number 2 the dynamos in use during the day and engine number 3 will be held in reserve. The foresight and care of Chief Engineer J. H. Dyblie in providing against stoppage by reason of a break down on the part of any one of the engines is to be commended.

Fig. 4 shows a ground plan of the boiler room. There are four boilers 65″ x 14 ft., and four 65″ x 18 ft. The relative position of pumps, tank for receiving condensation from the steam coils of the building, and filter is shown.

The plan devised for conveying coal from the area to the front of the boilers is unique and interesting. Upon an overhead traveller as shown in the elevation of the coal transmission system in Fig. 4 a bucket which runs upon a pulley is shown. This bucket is filled with coal at the bins, is then pushed along the track to the scales where its weight is recorded and then it is moved to the front of the boilers and dumped. It would be well-nigh impossible to use a wheelbarrow in the narrow space at command, especially in front of the 18 ft. boilers. But the travelling bucket is high enough to clear any heaps of coal that may be dumped in front of the boilers, and each load can be carried to the place where needed.

The filter incidentally mentioned in the second paragraph preceding is shown in Fig. 5, in perspective. The water of the Chicago river is notorious for being of nearly the consistency of liquid mud. Its use in steam boilers would render them useless within a very short time and in some localities it is well nigh impossible to use it in boilers on account of the foaming or priming it produces. On the other hand the use of water from the city mains means the expenditure of large amounts of money in payment of water taxes. With a consumption of about 10,000 gallons per day in the boilers of this plant the tax would be for water alone about $240 per month. By the use of the filter water from the river, which costs nothing, can be used, and the boilers are perfectly free from scale and are kept as clean as could be wished for. Fig. 5 shows the filter pump and small tank containing a coagulant. Each stroke of the pump draws from the chemical tank into the suction pipe a fixed quantity of the coagulant, which in passing through the pump is intimately mixed with the

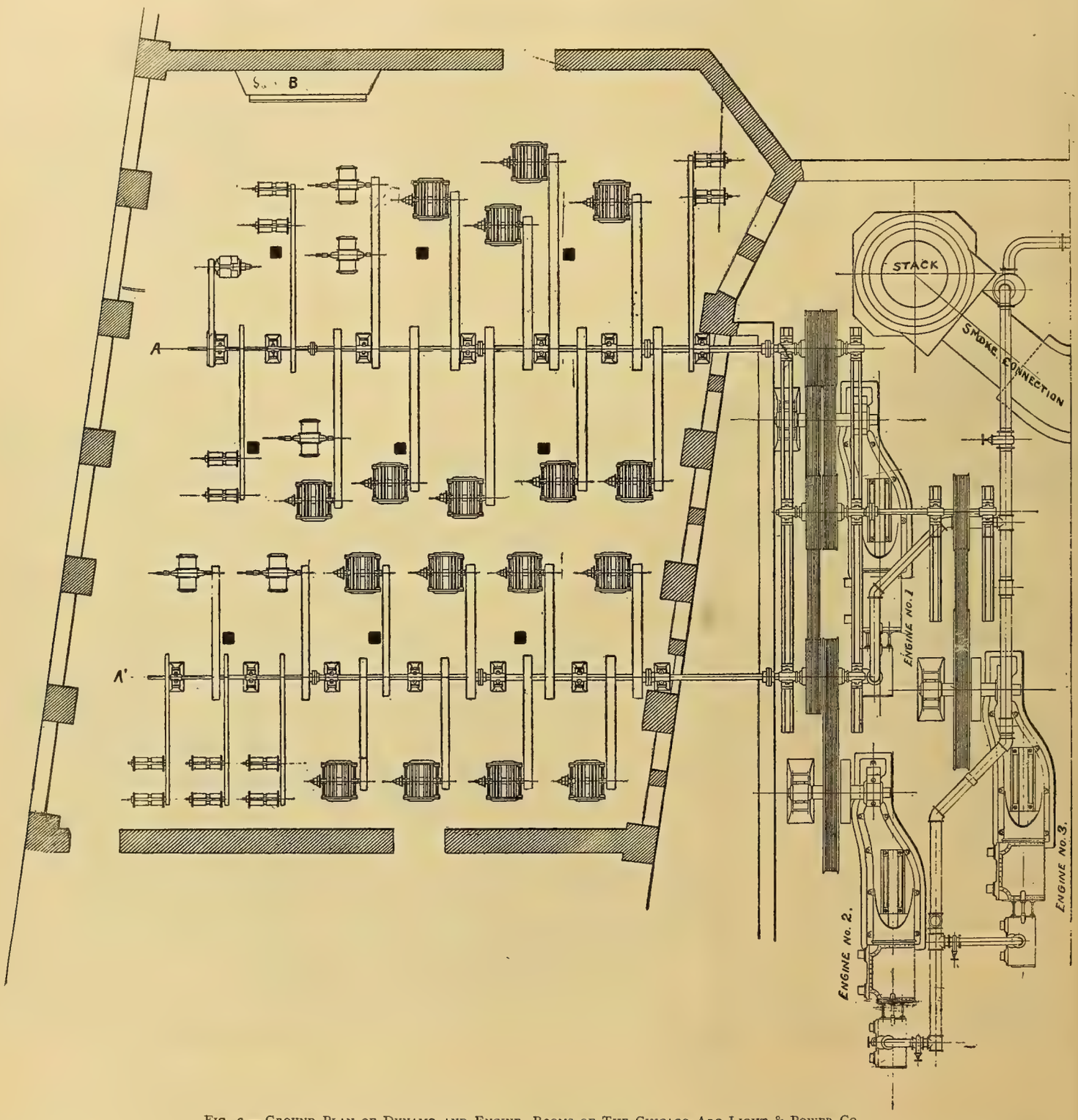
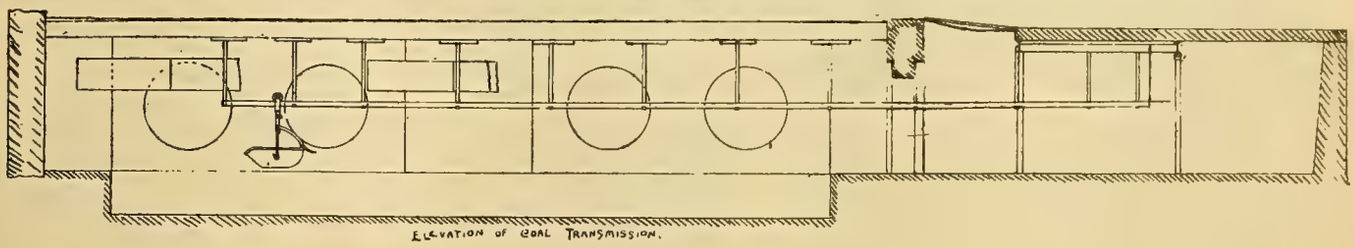


FIG. 2.—GROUND PLAN OF DYNAMO AND ENGINE ROOMS OF THE CHICAGO ARC LIGHT & POWER CO

water, causing perfect coagulation of the impurities and then passing to the filter is caught, together with the impurities, and retained in the sand, allowing only the purified water to pass out of the filter. A pipe is also connected to supply the chemical tank with water, which has attached, inside of the tank, a ball cock to control the flow and supply only the necessary quantity to replace that which is drawn out. This tank is open on top so that the operator can see at a glance how much chemical he is using and when it is necessary to replenish the material. In the pipe connecting the tank with the suction of pump, is placed a valve, H, with a graduated scale, enabling the operator to set it and use only a fixed and determined quantity to an absolute certainty.

It is a fact that when properly regulated there will not be found a trace of the chemical used for coagulation by the most careful analysis of the purified water as delivered by the filter. Such chemicals unite with the impurities, are retained in the filter bed and pass to sewer when the filter is being washed. By the use of sand cone valves it is possible to reverse the currents of water and thoroughly cleanse the sand of all impurities, in not over five to ten minutes time, and by no possibility can the filtering bed be carried or washed out while in the act of cleaning. The valves are automatic and positive in action. The outlet apparatus is also indestructible and reliable, being fitted with aluminum bronze, which can not corrode. In the act of washing a separate current is forced in a reverse direction through it, thus insuring its perfect working. When the filter is started in operation the valves B and E are opened and all the other valves are closed; when it is desired to wash the filter all the valves are closed, then A, C and F are opened and the try cock G is used, the flow from the latter being noted to determine the purity of the water; for rewashing the filter the valves B and D are opened, the try cock G being as before.

The care and attention necessitated in the



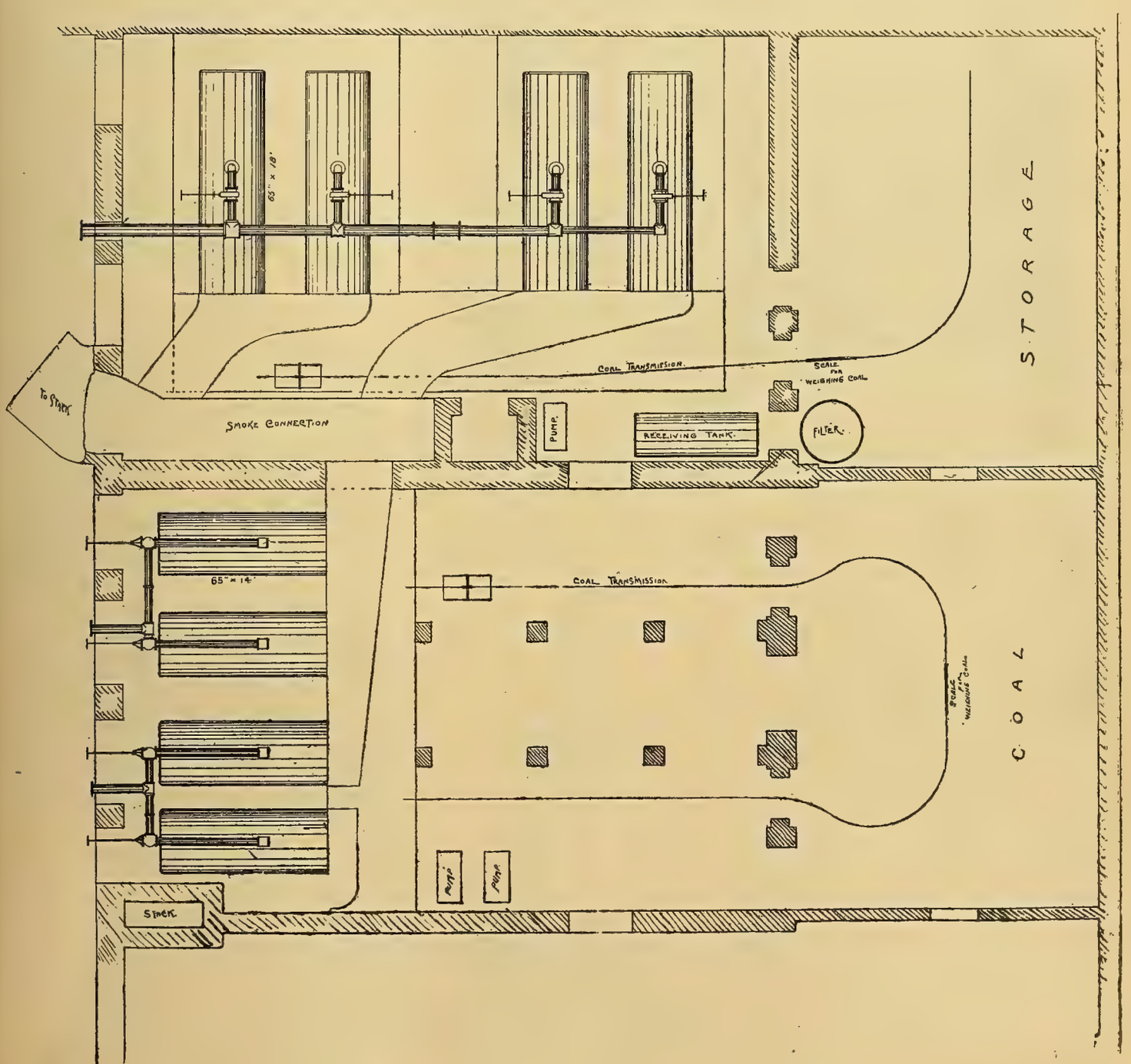


FIG. 3.—GROUND PLAN OF BOILER ROOM OF THE CHICAGO ARC LIGHT & POWER CO.

management of the whole plant can be appreciated by electricians particularly, and the immense amount of work of small detail, but nevertheless of great importance can be readily imagined. Running out of the station are cir-

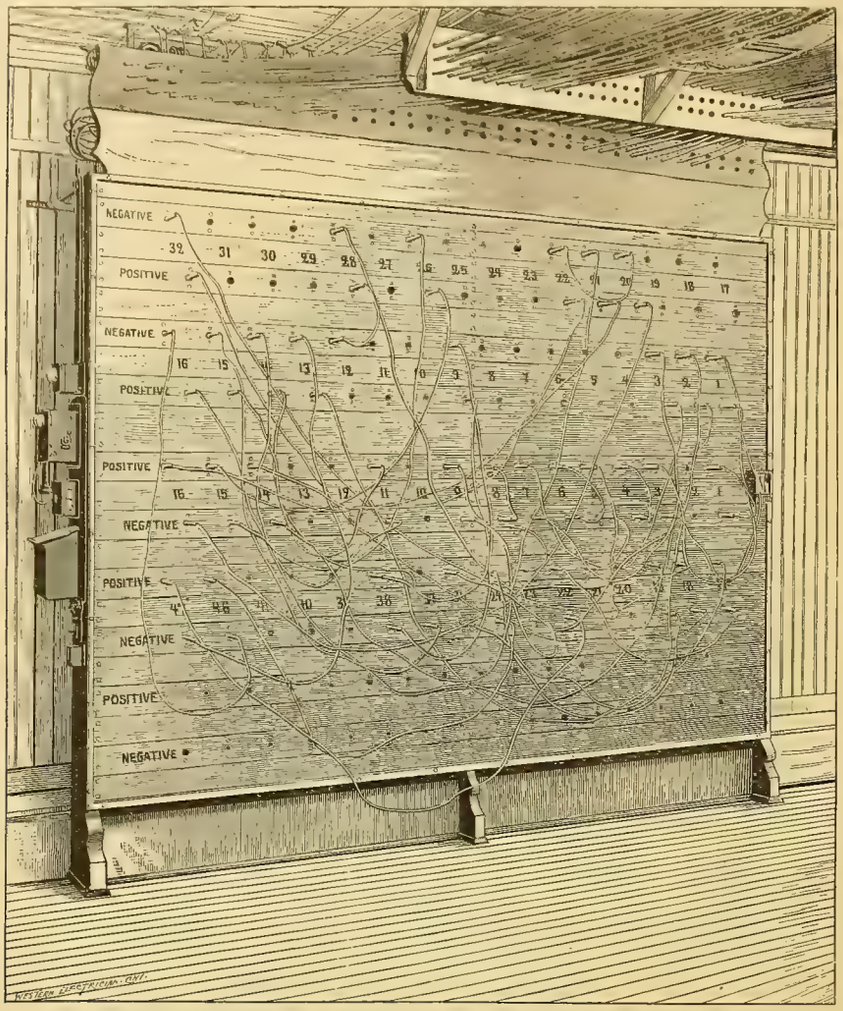


FIG. 4.—WESTERN ELECTRIC SWITCH-BOARD OF THE CHICAGO ARC LIGHT & POWER CO.

cuits that are in use from 7 A. M. to 6 A. M. the next day; from 7 A. M. to 6 P. M., from 8 A. M. to 12 A. M., from 10 A. M. to 10 P. M., from 2 P. M. to 12 P. M., and from 6 P. M. to 12 P. M. The longest run is of 23 hours—from 7 A. M. to 6 A. M., and between 6 A. M. and 7 A. M. that circuit is tested for resistance and insulation. Circuits that are in use at night are tested both in the morning and the afternoon. The location of all underground circuits, too, has to be recorded, and this work in itself is of the highest importance.

As a whole, the plant is a very interesting one, both from an electrical and mechanical point of view.

Western Union Figures.

Dr. Norvin Green, president of the Western Union Telegraph company, gave a number of interesting facts in his testimony before the senate committee on inter-state commerce recently. In 1868, the average expense to the company of handling a message was $63\frac{4}{10}$ cents. The average cost of messages to the public at that time was $\$1.04\frac{7}{10}$. The profit of the company has been reduced since from an average of 40 cents per message to $7\frac{4}{10}$. He said the company could demonstrate that since the consolidation of telegraphs in 1866 it has expended $55,600,000 in the plant. Thirty millions of this had been in actual money, and some of it had been in stock paid for other property. The persons who said that the government could send messages for 10 cents and make the line self-sustaining knew nothing about the business. It was utterly impossible. He believed that the Western Union property could not be duplicated for its cost. In response to a question of Senator Cullom, Dr. Green said that the Western Union property could not be reproduced for $80,000,000. There was a prevailing impression, he said, that the property was controlled by one man. This was an error. The facts were these: The thirty directors of the company held less than $27,000,000 of the stock, leaving nearly $60,000,000 in the hands of sundry parties. The largest holding of any one man was a little over $20,000,000. The voting power, outside of the property, was larger than the voting power inside of the property, and the action taken by the company was not always in accordance with the wishes of the large stockholders.

Coming to what he described as the objectionable features of the bill reported by the post-office committee, he referred to the section relative to the handling of messages according to the time of their receipt. He said that in the smaller offices that rule could be easily observed, but not in the larger offices, like New York, with 1,200 wires. One operator might work faster than another and it would be almost impossible to exactly distribute the messages and keep them in their precise order. Therefore he believed that the section should be qualified by the addition of the words "as nearly as possible." The general scope of the section forbidding discrimination in forwarding messages also sufficiently covered the case without the specific requirement. As to the long and short line clause, he said, in answer to a question, that no higher tariff was charged between points on the lines from New York to Omaha than between the terminals. If the second section of the bill gave the Inter-State Commerce commission the right to say what charges were unreasonable, it would amount to a confiscation of the companies' lines.

Dr. Green said that his company would like to have an amendment adopted settling the question of liability of his company as to the production of telegrams under subpœnas from courts and committees He would like to see a provision in the bill limiting the damages to be paid for delay in the transmission, say, to 500 times the amount paid for the transmission. That, he thought, was a reasonable rate. It was perfectly absurd that a telegraph company should be subjected to $25,000 or $50,000 damages for delay in a message for which 25 cents was paid.

Phœnix Building Motor System.

An important addition has recently been made to the Phœnix building electric plant, one of the most complete and best equipped in Chicago. The Phœnix building which is one of the handsomest structures in the city is at the corner of Clark and Jackson streets. It was necessary to supply the offices with fresh air and with this purpose in view three motors were purchased of the Sprague Electric Railway and Motor company, C. M. Barclay, western agent. The motor station is above the upper floor of the building. It has not yet been fitted up, but the station will shortly be supplied with all the appliances and conveniences needed for its successful operation.

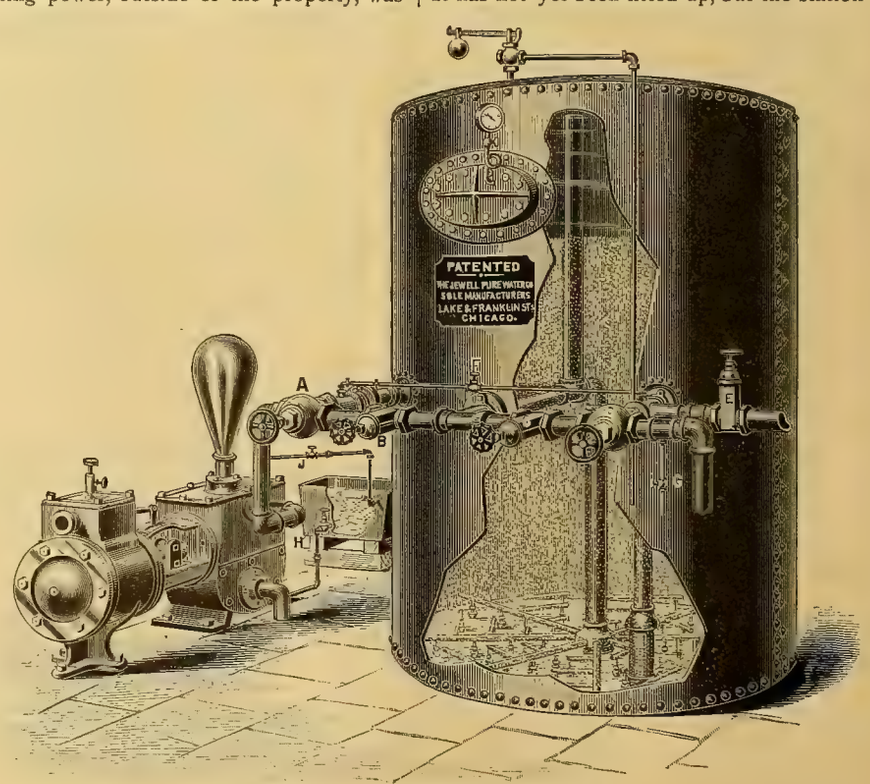


FIG. 5.—FILTER OF THE CHICAGO ARC LIGHT & POWER CO.

A representative of the WESTERN ELECTRICIAN was given an opportunity of inspecting the plant by the chief engineer John G. O'Neil. The

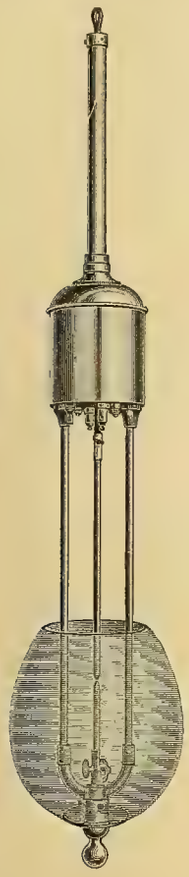


FIG. 1.—VAN DEPOELE SINGLE CARBON LAMP.

latter said the motors had been found by the tests to work admirably and incidentally he remarked that he thought the electric motor would solve the problem of supplying small power.

Two of the motors are of ten horse power and the third is just half that capacity. They are employed to drive three Blackman ventilating fans, two sixty inch and the third a forty-eight inch. The fans' revolutions are about 500 per minute. It is proposed to run the motors continually, summer and winter, and thus supply the rooms with a constant supply of pure air.

The current is supplied from the dynamo station in the basement. The wires run through the elevator shafts. A system of electric signals is to be arranged, by means of which the man in charge at the motor station can communicate with the engineer in the basement.

The dynamo station in the basement is complete in every particular. Three Edison No. 16 dynamos are in position. In the building 1,318 incandescent lamps are furnished with current. Their life, Mr. O'Neil says, will average about 1,500 hours. All the machinery is in duplicate, so there is no possible danger of a breakdown in the system.

Underground Conductors in Milan.

To the Editor of WESTERN ELECTRICIAN:

CHICAGO, April 30.—During the discussion following the reading of Professor Badt's paper at the last meeting of the Chicago Electric club, Mr. Cutter said with regard to the sectional underground conductors in Milan, Italy: "They have a large network, and they are taking it pretty much all out." Permit me to say that I believe Mr. Cutter to be misinformed on this matter. In a communication from Mr. Lieb, general superintendent of the Milan station, received by me since the discussion alluded to, he writes:

"It was reported that the tubes had all been taken up in Milan, but such is not the case, as only 15 or 16 of the two thousand (2,000) tubes laid in Milan have been taken up, and but a few of these had their insulation affected."

W. S. ANDREWS.

At a recent meeting of the Chicago West Park commissioners it was stated that a large number of trees had been killed by the leaking of gas mains. Commissioner Blount said, "The shiftlessness of that gas company has cost us over $4,000 in trees during the last few years. They will have to move their mains, stop up the leaks, or pay for our trees."

Van Depoele New Electric Lighting System.

The disposal of the electric motor business of the Van Depoele Electric Manufacturing company to the Thomson-Houston Electric company has given the former the opportunity of devoting more attention to their electric light system and working out improvements that had been suggested. The dynamo and lamps have been changed in many respects, and now the Van Depoele company can claim as perfect an arc lighting system as there is in the country.

Figs. 1 and 2 represent new styles of lamps, the former a single carbon, or standard lamp, and the latter a double carbon lamp. As will be seen the rods for supporting the globe pass down within the globe instead of upon the outside. The lamps are compact, neat and artistic.

Features in the construction of these lamps are two electro magnets, one in the main and one in the shunt circuit; to the latter is hinged a soft iron armature, the free end of which moves under the influence of the opposite pole of the main magnet. This armature carries the carbon lifter, so that any motion imparted to the armature, under the influence of its electro-magnets, is directly communicated to the lifter, either separating the carbons or allowing them to feed. Another and most important feature is that the lamp needs no adjustment after it is made, thus doing away with all tampering by attendants, which has in many cases caused the failure, within a short time, of many plants. These lamps are provided with an automatic and hand cut-out, so that any lamp can be cut out or in circuit without affecting the others. All parts of this lamp are very plain, and are not many; but all are made absolutely accurate with special machinery. All parts are interchangeable.

Fig. 3 shows a focusing lamp for the use of the lecture room. The lamp is mounted upon a solid stand, and can be moved horizontally and vertically to any desired angle. The working of the lamp is perfect and reliable, and any candle-power can be given, from five hundred to twenty thousand or more. The reflectors used in conjunction with these lamps have to be chosen to correspond with the work to be done. Any range

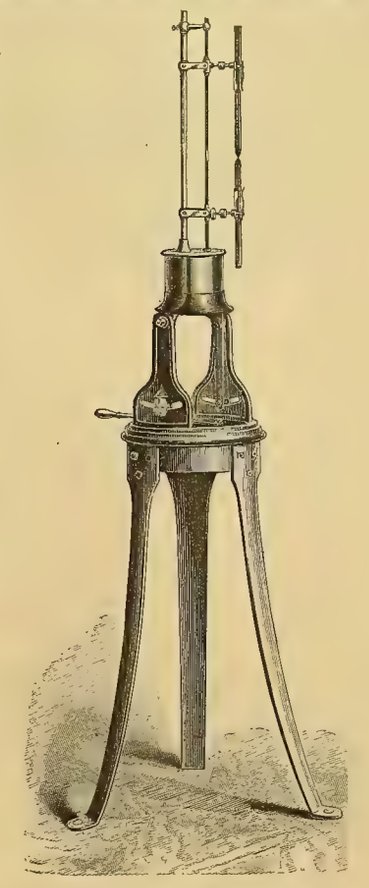


FIG. 3.—VAN DEPOELE FOCUSING LAMP.

from one mile to ten can be furnished, or manufactured to order.

The main features of the Van Depoele dynamo shown in Fig. 4, consist in the peculiar disposition of the field magnets, the construction of the armature, the extreme simplicity of all parts of the apparatus, great compactness, and, the ease of

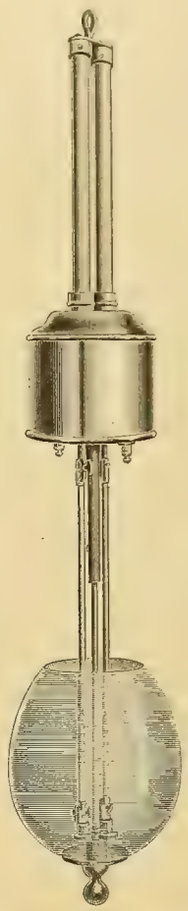


FIG. 2.—VAN DEPOELE DOUBLE CARBON LAMP.

management and control of the current to the work called for. The field magnets consist of two large coils of copper wire wound around two soft iron cores, their north and south poles facing each other, and between these poles revolves the armature. To the soft iron cores of the field magnets are cast on one end heavy back plates, while to the other end are secured the semi-circular pole pieces between which the armature revolves in close proximity to the latter. The back plates of the magnets are secured between the top and bottom plates holding the whole in position and making a most solid frame. To the lower plate, and in its center, which is neutral, are cast two extensions upon which are placed the posts or bearings supporting the armature shaft; this disposition allows the posts to be comparatively short, providing a very rigid support for the revolving armature. Further, the whole frame may be considered as a very long electro magnet, with its poles inverted toward its center.

The armature shown in Fig. 5 consists of a frame made of a number of iron bars, each separated from the other; these bars are riveted to the inner and outer periphery of two metal rings, several of these rings being placed between the inner and outer layer of iron bars. And finally, the rings and bars are riveted together so as to form a solid frame. The difference between this form of core and the Pacinotti or Gramme ring will be apparent at a glance: The Gramme ring is composed of several layers of soft iron wire coiled one upon the other, forming the armature core, upon which the copper wire is ultimately wound in sections; the magnetism of the fields can act but very little or not at all upon the copper wire coiled on the inside of the ring thus made, since this wire adds only to the resistance of the machine, without doing any service in the production of useful currents, the only effective portion of the wire being that close to the field and on the outside of the ring; whereas, the Van Depoele armature being built up of several rings, —distanced one from the other—and the bars also distanced one from the other, an opening is thus provided all along and around the whole core. It will readily be seen, therefore, that the

magnetism of the field can easily reach the wire wound on the inside of the cylinder, or armature, making every inch of wire in this armature pass under the direct influence of the field of force, thus accounting for the great efficiency of the Van Depoele dynamo.

Another and very important advantage offered by this construction is that these bars being wound — each couple of bars with one section of wire — and the iron bars not touching one another, the magnetization and demagnetization of the same is effected instantaneously, and adds to the efficiency of the machine, since all local action is thus avoided.

Fig. 6 shows the Van Depoele automatic switch and current indicator combined, the whole contained in one frame, with all parts in sight and easy of access. The function of the combination of the apparatus is: First, to indicate correctly the condition of the current, whether one lamp or the whole number the generator can supply are running, showing at once if anything wrong is going on along the line, or with the generator, so that no matter how long the service line, at any time can the condition of the working circuit be seen. The second function of the apparatus is the automatic switch. In case of accidental breaking of the main or working circuit, the automatic switch lever, which was at first kept down by the electro-magnet in the main circuit, is now carried upward and breaks circuit, with the current, which energizes the fields of the dynamo, thus preventing any further current to be generated, and saving the machine harmless.

To Frighten Burglars.

"Do you know what kind of a burglar alarm I shall have in my house!" said a gentleman interested in an electrical business. "I shall not have a little bell near my bed to awaken me if any one opens a door or a window. No, sir. I shall have an eighteen inch gong put up in the center of my house and then connect every door and window. If a burglar opens a door or window then the noise will scare him away at once. Suppose I have a little bell in my room, that wakes me up; what good does that do? I have to get up, dress myself, and go down and drive that burglar away. He hasn't heard the bell and I might find him and that's just what I don't want. The kind of alarm I shall have will give the burglar warning that I am coming and afford him an opportunity to leave. I have no desire to fight burglars. I have no desire to be a hero. I want to scare them off without running any risk myself. What burglar would have the impudence to keep on stealing with an eighteen inch gong striking fifty times a minute! Then, when the danger is over, I can go down and lock everything securely. What do you think of the scheme?"

Lighting Trains by Incandescent Lamps.

The facts in the following article are taken from a description of the Timmis system of train lighting, contained in *Industries:* Although on first glance the problem of lighting railway carriages by incandescent lamps seems a simple one, careful consideration shows that it is coupled with many difficulties, which arise chiefly from the necessity of so arranging the lights that they may be independent of each other, no matter how the train is made up. Various methods from time to time have been brought forward, and among those which were most successful, or, to speak more correctly, the failure of which was the least conspicuous, we may mention the following: First, the direct system of lighting by means of a dynamo driven by a separate engine, and supplying current to mains which run the whole length of the train, and to which the lamps are connected. In an installation of this character on a London suburban train, the dynamo and engine were placed in the front guard's van, and the lighting was under the control of the guard. Another example, was the experiment made by the Great Eastern railway, some four years ago, when several locomotives were fitted with steam dynamos, and a cable, with special couplings, was laid throughout the train, from the locomotive to the last carriage, branches being taken off to the glow lamps, which were all coupled in parallel. The great objection to either system is that all the carriages in the train must be provided with electric fittings, for, if a carriage not so fitted be inserted, all the carriages behind it would be cut off from the supply of current. Another objection is, that if the train has to be split up at a junction, and one portion be coupled to a train not provided with the same electric light apparatus, this portion will not be lighted at all, since the usual oil lamps have been replaced by incandescent lamps. The system appears therefore only applicable to short suburban trains, the make-up of which is never altered. The system is also objectionable because of imposing upon the engine driver or guard the additional duty of attending to the steam dynamo. This duty becomes particularly irksome on lines containing many tunnels, because, in the daytime, the dynamo must be started and stopped each time the train passes a tunnel. Secondly, the combined dynamo and battery system of electric train lighting, which is in use on a number of trains on the Brighton company, and which has also found considerable favor on the Continent. The essential features are a dynamo and a set of accumulators, the dynamo being placed in the guard's van, and driven by belt gear from one of the axles. Automatic appliances are necessary to keep the electromotive force of the dynamo within such limits as will insure the batteries not being damaged by an excessive charging current on the one hand, and will, on the other hand, prevent a back discharge from the battery through the dynamo. For the latter purpose, an arrangement must be provided which interrupts the charging circuit when the speed of the train, and therefore that of the dynamo, has fallen below a certain limit. All these automatic appliance are objectionable, because of their liability to get out of order. The dynamo and gearing take up a large amount of space as the guard's van, which is of great value in main line trains; and the belt gearing, which is necessarily more or less exposed to dust on the road, entails a heavy outlay for maintenance. The depreciation of the dynamo and engine is also great, because guards' vans are often left standing on a siding, and the machinery is therefore liable to be neglected. Another objection is, that while the batteries can not be charged when the train is standing, the gear must always be worked when the train is in motion, whether the light be required or not. Thirdly, the system of subdivided batteries with or without dynamo carried on the train. The essential feature of this system lies in the employment of small storage batteries, one being fitted to each carriage. It is evident that by this means the lighting of each carriage is rendered perfectly independent of the other carriages, and also independent of the way in which the train is made up; but as hitherto carried out, the control of the lights in each carriage during the day when the train is going through tunnels, could not be effected from one place in the train by the guard, as in the previous systems. The lamps must therefore either be under the control of the passengers, or an attendant must be provided for every carriage. This system has since the beginning of the year been in use on the Alsatian State railways, where the battery of each carriage consists of thirty-six cells carried in a tray, for facility of handling at the charging station. The batteries, which are of forty ampere hours capacity, are fitted in the place of the gas reservoirs underneath the carriages, and are charged at certain stations which already possess electric lighting plant. Each carriage is fitted with five ten candle power lamps, requiring together about three amperes of current, so that the batteries have sufficient storage to light the train for thirteen hours before being re-charged.

A similar system of electric train lighting has been introduced into England by J. A. Timmis; but it is a great improvement upon the system in use on the Alsatian lines, and has been worked out quite independently. Mr. Timmis employs sub-divided storage batteries, ten of the Union company's cells being placed under each of the carriages composing the train; but the lighting and extinguishing of the lamps is performed by the guard and not left to the passengers, thus removing the objection we have above alluded to. There are, however, other advantages connected

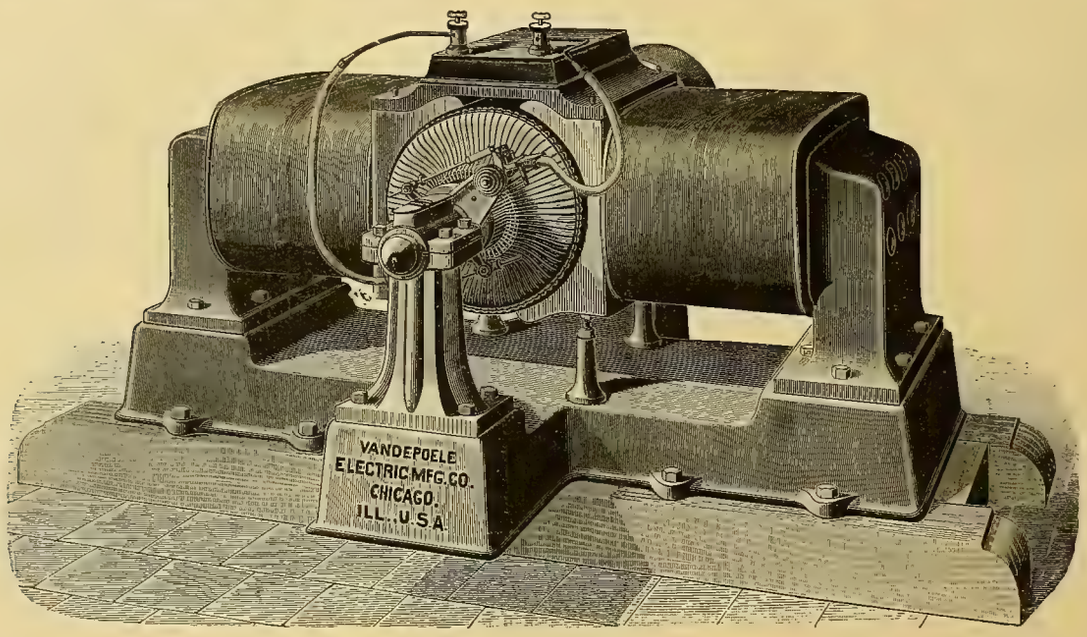


FIG. 4.—VAN DEPOELE DYNAMO.

with this system which we shall presently describe. Experiments with the Timmis system were begun on the Midland railway in October last, and an electrically lighted train is now regularly running between Derby and Manchester. The light is supplied to a saloon carriage, a composite first and second class carriage, and the guard's van. Each battery, as already stated, consists of ten of the Union company's storage cells, and weighs about 4cwt. These batteries are charged by a dynamo at the station at Derby, and supply current to five candle power Swan lamps, of which two are placed in each compartment of the ordinary carriages, and four in the saloon. In this system, Mr. Timmis does not only provide for the electric lighting of each every carriage independently of the others, but

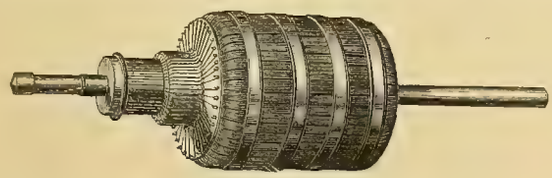


FIG. 5.—VAN DEPOELE ARMATURE.

he also utilizes the electric apparatus as a means of inter-communication between passengers, guard, and driver, and to a certain extent as an automatic alarm which will give notice in case the train parts. It is not necessary that the storage cells should be charged at the station, and Mr. Timmis has elaborated an arrangement by which the train is rendered perfectly independent of a fixed charging station, each locomotive being provided with a steam dynamo, which is used for charging all the batteries in the train from mains running from the locomotive to the last carriage. In elaborating his plans, he laid down the following conditions as essential to meet the requirements of railway engineers in lighting trains electrically: (1) Every vehicle must carry its own lighting power, because it may be put into a siding, or be slipped or break loose from the train; (2) The guard of the train must have the power to light or put out all the lamps in the train without quitting his van; (3) if a portion of the train is slipped or breaks loose, the lamps in that portion, as well as in the front part of the train, if lit, must remain lighted, and if they are not lit they must automatically light up so as to give the passengers warning that an accident has happened. This last condition is important, because it may happen that a train parts after leaving a tunnel, and while ascending an incline, when the rear vehicles will run back into

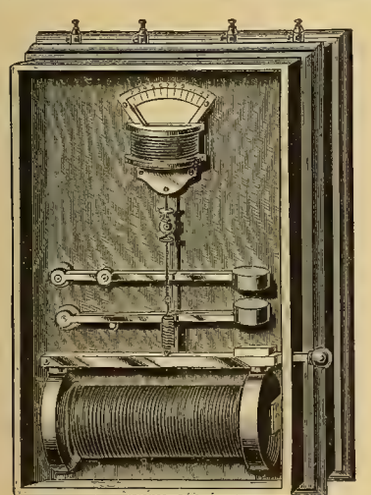


FIG. 6.—VAN DEPOELE AUTOMATIC SWITCH AND CURRENT INDICATOR.

the tunnel. If such an accident happens in the day time, the lamps in the whole of the train will automatically light up, and thus give notice that the train has parted.

Cincinnati Exposition Electric Plant.

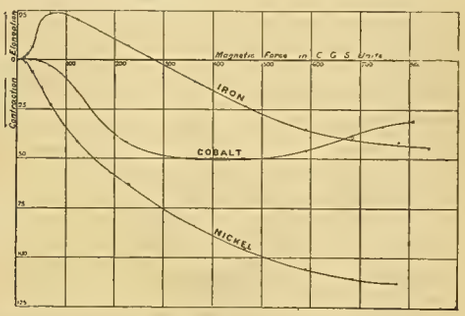
The contract for lighting the Cincinnati Centennial Exposition buildings has been awarded to the Western Electric company, of Chicago. The contract calls for the installation of 175 lights. The dynamos and other apparatus will be in place June 1st, in accordance with the contract. The buildings to be lighted include one permanent structure and several temporary structures, one of which will be of large dimensions. The committee which has the management of the centennial has a fund of $500,000 to draw upon to complete the preliminary arrangements. The exposition will open July 31 and will continue three months. During this time one of the Western Electric company's experts will have charge of the plant.

Testing Laboratories.

In speaking of the electrical testing laboratories in Paris and Vienna, *Science* says: "The establishment of these two laboratories is important. The applications of electricity have rapidly advanced, and have assumed a permanent character. The questions in many cases are not, 'Can electricity do this?' but, 'How cheaply can it be done?' and this last question can only be answered by measurements. As competition increases, and as that part of the public looking for investment becomes less satisfied with the mere running of a machine, and demands accurate measurement of its performance, the necessity of some reliable means of comparing measuring instruments becomes necessary. In England, the Central Institution of London has undertaken the work; in Austria, the Technological Museum at Vienna; in France, the International Society of Electricians. Our country has outstripped all others in the applications of electricity. Probably we will soon have some means of comparing electrical apparatus, and testing the value of the numerous appliances daily patented. Electrical progress has been retarded and discredited by worthless patents in which a great deal of money has been invested and lost, while a simple test, taking a little time and made at little expense, would have shown them valueless."

The Elongation and Contraction of Metals in Magnetic Fields.[1]

It has long been known that a bar of iron when magnetized by a surrounding solenoid alters its length, and with the weak magnetizing forces which were originally employed in these experiments, the alteration was invariably an increase in length. One of the earliest experimenters, and probably the original discoverer of this behavior of iron when magnetized, was Joule; but he invariably found that the length increases with the magnetizing force. In his experiments, however, the magnetizing force did not exceed 87 C.G.S. units, and an ingenious theory was propounded to show that elongation must take place when a bar of iron is magnetized. It was believed that the molecules as they rotate under the influence of the lines of force, and become more or less parallel, they naturally require more room in the direction of the length of the rod, and therefore cause the latter to extend with a corresponding decrease of diameter. This simple explanation was refuted by the experiments of Shelford Bidwell, which he made some years ago, and in a paper communicated by him to the Royal Society in 1885, he showed that the elongation does not remain unchanged at its maximum when the magnetizing force exceeds that which is sufficient to produce so-called saturation; but, on the contrary, that with increasing magnetizing forces beyond this limit the elongation becomes less until the rod, after returning to its original length, ultimately becomes actually shorter than it was in the unmagnetized condition. Shelford Bidwell has, however, recently contributed to the Royal Society, another paper on the same subject, and in this he points out that his original investigations might be open to the following objections: (1) The field due to the magnetizing solenoid was not quite uniform; (2) the effect of the ends of the rods was uncertain, and might have played some material part in the production of the phenomena in question; (3) all the rods used in the experiments retained a certain amount of permanent magnetism. To meet these objections he has carried out a further series of experiments by using rings instead of rods of iron, and observing the changes of diameter. The rings were also demagnetized before every observation, and the battery employed was much stronger than that used in the first experiments, so as to produce very great magnetizing forces. He found that in their general character the phenomena of elongation and contraction were the same with the rings and with straight bars, thus proving that the effect of magnetization was independent of the form of the iron, and as it was much easier to obtain intense fields with straight than with circular solenoids, the author made some further experiments with straight rods. These experiments embraced iron, cobalt, nickel, manganese steel, and bismuth, and the highest magnetizing force reached was 840 C.G.S. units. We are able, by the courtesy of Shelford Bidwell, to publish herewith a diagram showing the behavior of iron, cobalt, and nickel in magnetic fields of varying intensity. The strength of field is plotted on the horizontal, and the change of length in ten millionths of the original length of the rod is plotted on the vertical, the elongations being plotted above, and contractions below the axis. The line of bismuth, which metal was tested in fields varying from 500 to 840 units, almost coincides with the axis, and manganese steel was also found to be almost unaffected, the elongation in a field of 850 units being only about one-fifty millionth of the length. That the change of length in the other metals which are sensibly affected by magnetization can not be due to the



mechanical stress produced by magnetic attraction between the ends of a bar, is shown by the author in the case of iron where mechanical stress does not account for more than one-fifth part of the observed magnetic contraction. It should also be remembered that up to a magnetizing force of 280 units, iron elongates, and, therefore, the mechanical stress in iron opposes magnetic extension.

1 *Industries*, April 13, 1888.

St. Louis Mercantile Library Association Building.

The contract for lighting the Mercantile Library Association building at St. Louis has been awarded to the Excelsior Electric Light company, F. W. Horne, Chicago, western agent. The contract calls for 100 arc lights. The association building on Fifth street is one of the finest structures in St. Louis, and the competition was unusually active. Robert S. Brookings, who is president of the library association, has for a considerable time been engaged in testing different systems. He employed an expert for this purpose and examined various circuits carefully with instruments. As he made the award to the Excelsior company after this inspection, Mr. Horne feels decidedly elated. The work will be completed July 1st. The building when in course of erection was wired throughout.

The process of cutting glass tubes by electricity has succeeded admirably. The tube is surrounded with fine wire, and the extremities of the latter are put in communication with a source of electricity, and it is of course necessary that the wire adhere closely to the glass. When a current is passed through the wire, the latter becomes red hot and heats the glass beneath it, and a single drop of water deposited on the heated place will cause a clean breakage of the glass at that point. Contrary to what takes place with the usual processes in the treatment of this frangible material, it is found that the thicker the sides of the tube are the better the experiment succeeds.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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Notice to Subscribers.

We are pleased to state that arrangements have been made by the publishers of the *Electrical Engineer* of New York and the publishers of the WESTERN ELECTRICIAN, whereby a year's subscription to both journals can be had for five dollars ($5).

A year's subscription to the WESTERN ELECTRICIAN costs three dollars ($3), and a year's subscription to the *Electrical Engineer* costs a like amount, or if the two journals are ordered independently, the cost to the subscriber is six dollars ($6); but by sending subscriptions to this office for both journals, subscribers can secure them for a year for five dollars ($5), thus saving one dollar ($1).

AN unusual demand for both news and advertising space has increased the number of the pages of the WESTERN ELECTRICIAN this week.

The fact is gratifying in that the issue has an enhanced value to the reader and bears most convincing testimony that this journal is steadily growing in the appreciation of advertising patrons, who find in it a valuable medium for placing their wares before purchasers.

Newsy, well illustrated, bright and handsome the paper is commended to the careful perusal and study of the reader, the advertiser and purchaser.

IN the wide range of correspondence published this week will be found many indications of a busy and prosperous season for electrical industries. The outlook is very encouraging.

THE plant of the Edison Electric Light company at Fall River, Mass., was burned last week. The loss was $150,000. If the company is like most electric light corporations, it will soon be in active operation again.

THE discussion of the general subject of the "Continuous current *vs.* the alternating current," will be resumed by the Chicago Electric club next Monday evening. Mr. Cutter is announced to read a paper, taking the alternating side of the question. He is a strong and able advocate of the alternate current as the reports of discussions of previous papers have shown, and it may be confidently expected that he will make a strong argument in favor of the alternating system.

AN ELECTRIC light plant of more than ordinary importance, that of the Chicago Arc Light & Power company, is so fully described and illustrated in this number that little is left to be said except that mechanical and electrical engineers will find in the views and drawings much to interest them and quite possibly will secure hints or suggestions that will be of future service. It will be seen that with the space at command wisdom and foresight have been shown in the arrangement of both steam and electrical departments of the plant.

A CONTRIBUTOR in the *Manufacturers' Gazette* mentions the retirement of a Philadelphia engineer, and says: "The cause was that the electric light having been introduced, a man who was 'up' in electricity, as well as in steam, was necessary to the position. Here is a tip for the young mechanic. In ten years from now every mechanic must possess a knowledge of electricity, or he will have to step aside and see a more capable man take his place. Electricity is one of the most interesting things a man can study, and it is strange that no more attention is given it by young men."

THE latest complaint about the Chicago North Side cable road is that the cars cannot be stopped by the brakes when on the decline leading to the tunnel. A correspondent of a daily paper alleges that he will no longer ride on these cable cars because of an exciting race which occurred a few evenings ago. A team was in front of the car; the gripman applied his brake but to no purpose. Nothing remained to the driver of the cart but to lash his horses and do his best to get out of the tunnel first. Fortunately for all parties concerned he managed to reach the open air before the pursuing car but still the occupants of the latter vehicle wished for less excitement. They longed for an electric motor which could be perfectly controlled and could always be relied upon.

THE selection by President Cleveland of Hon. Melville W. Fuller, of Chicago, for the chief justiceship of the United States supreme court is an appointment gratifying to republicans and democrats alike. No act which President Cleveland has performed has been so universally approved. At his home Mr. Fuller is known as a lawyer of great attainment, a man of firm character and high principle, a gentleman of courteous but dignified bearing. The members of the Chicago bar seem to approve the choice without exception and to unite in saying that a better appointment could not have been made. But the knowledge of Mr. Fuller's fitness for the highest judicial office in the gift of the nation is by no means confined to the city in which he resides. Throughout the country he is favorably known, and at all points members of both parties combine to approve the president's wisdom.

THE paper of R. E. Crompton on "Transformers *vs.* accumulators," of which an abstract appears in another column is a valuable addition to the literature on the subject of electrical distribution. It is the result of the discussion of the papers of Messrs. Kapp and Mackenzie before the London Society of Telegraph Engineers and Electricians. In that discussion Mr. Crompton put himself on record as a prophet in predicting that the lighting of the future would be monopolized either by the battery transformer or by the alternating current transformer system. He thought the storage battery system more reliable and cheaper. In the paper of which an abstract is given he elaborates the reasons for his belief. Unquestionably he makes out a strong case. Mr. Crompton compares the two systems from four standpoints, reliability; first cost of plant; working cost and maintenance and output and income, and he contends that the accumulator system shows superior features in each respect.

THE dispatches announce that a New York bookkeeper on the Bowery was killed last week while attempting to regulate an arc light which was not working to his satisfaction. This is the second death caused by the wires in New York city within a month. It is only fair to add, however, that it is only the fourth which has occurred in connection with electric illumination in that city for seven years. In this case it would seem that no one but the unfortunate man was at fault. Storekeepers had been repeatedly warned not to meddle with the work which belongs to the expert but they are, it is stated, habitually unmindful of these frequent cautions. When the light becomes dim they take a ladder and propose to remedy the difficulty at once in utter disregard of the danger which they incur. If this fact is true, and it comes from good authority, the only wonder is that the number of victims has not been much larger. The moral of the fatality is not as some of the New York journals seem to think that all wires should be forthwith buried, for in that event the lamps from which the current was communicated in this instance would still be overhead, but the lesson seems to be rather a warning to the consumer to allow the experienced electrician to do the work which he alone is qualified to perform.

ON the 26th ult. there was a severe gas explosion in a clothing store at the corner of Quincy and State streets, Chicago. Employes of the Chicago Arc Light and Power company were engaged in the basement of the store driving an iron tube through the wall and street to the opposite side of the street, this being work preliminary to putting in an iron pipe for electric light wires and necessitated in a city where in certain districts overhead wires cannot be strung, nor granite pavements torn up except for the purpose of repairs. The proprietors of the clothing store demanded the electric light in order to keep pace with neighboring rival merchants in the same line of trade. Wires could not be run aerially across the street, the pavement could not be torn up to lay the conduit and there was no other way of getting the wires across the street except by burrowing or tunneling, and the company resorted to the plan described, which has been practiced for five years at least, as a last resort. Unfortunately, the driven pipe punctured an old gas pipe, and an ignorant helper, with more curiosity as to where the gas that was palpably escaping came from, than appreciation of the possible consequences, applied a lighted candle to the end of the driven pipe. Naturally, there was a tremendous explosion, which by good chance resulted in slight injury to only three persons. The damage to property, however, was great. Of seventeen large plate glass windows only one withstood the explosion. Partitions, shelves, glass, plastering and goods were mixed into almost inextricable confusion. The loss on property was probably in the neighborhood of $5,000.

The wisdom of the practice of driving pipes in the manner indicated might be questioned. For five years it had been followed and with experienced men in charge no accident had resulted, but at last the day came and more by good fortune than anything else, no persons were more than slightly injured. No record has ever been kept of the locations of gas and water pipes laid in the streets but the arc light company has always aimed to drive its pipes five feet or more below the surface of the street and consequently below the lines of gas pipe.

The arc light company has now discarded this practice and will find some other way of laying conduits.

The accident is worthy of mention in this place as illustrative of the difficulties entailed by a public demand for the undergrounding of electric wires. The company in question was hampered on the one hand by the city ordinances forbidding the tearing up of the street to lay a conduit across the street, and on the other hand by ordinances forbidding the running of wires upon poles or overhead, and yet here were merchants demanding the electric light and the company was bound to supply the demand. The undergrounding of wires possesses many obvious advantages, but those advantages, as shown, are accompanied sometimes by great disadvantages.

Central Station Lighting—Transformers vs. Accumulators.[1]

R. E. Crompton read a paper on Transformers *vs.* Accumulators at a recent meeting of the London Society of Telegraph Engineers and Electricians. It was an outcome of the discussion on Messrs. Kapp's and Mackenzie's papers, which have provoked such widespread interest among those who are studying the contributions to the literature relating to the alternating and continuous current system.

Mr. Crompton gives this description of the accumulator system which he calls the B. T. system:

At Vienna, the arrangements proposed by Mr. Monnier, and successfully carried out by myself and others, consist of charging from a central station groups of batteries of accumulators arranged in series. Each group of accumulators consists of 52 cells, giving the 100 volts required for the lamps, with a comfortable margin. The total e. m. f. required to charge the four groups of batteries in series varies from 430 volts, at the time the batteries are giving off work, to 480 volts, for the short time during which the charge is being completed. This includes the loss in the mains, generating stations being situated 1,400 yards from the distributing station. During five hours of lighting about two-thirds of the current comes direct from the dynamos; but during this time for short periods the demand of current often increases to such an extent that these proportions may be reversed, and the batteries supply two-thirds of the total. As this system has now been in use for upwards of nine months without any hitch or trouble whatever in connection with the electrical work, we may consider it proved there is no danger or difficulty in using currents of such high e. m. f. as 480 volts connected permanently to the distributing mains. The system may, of course, be united with three or two groups only in series. An example of the last is the central station belonging to the Lemans Gas company.

I now propose to commence my comparison of the two systems from four points of view :—1st, as to trustworthiness, steadiness, and quality of the lighting; 2d, as to first cost of the plant; and 3d, as to working cost and maintenance; 4th, as to the probable output, and hence maximum income, that can be safely obtained from the sale of electricity in each case.

I think it will be allowed that the commercial success of an electric light undertaking depends on these four points. I do not propose to dwell much on the first point. It is generally admitted that a system which uses storage must be superior to a system in which the continuity of the lighting depends entirely in moving machinery. There are many reasons why I should not make invidious comparisons on these points between existing systems. No one is prepared to dispute the facts that the A. T. [transformer] systems hitherto installed have been remarkable for frequent interruptions in the lighting, whereas the reverse has been the case with the B. T. system. It remains for us to consider whether the undoubted great advantage which the B. T. system possesses in this respect is not purchased too dearly; and this matter will occupy the remainder of my paper. The comparison I now make is for a system of electrical supply for London for 10,000 60-watt lamps, or their equivalent, simultaneously alight at hours of maximum demand:—1st, by alternating currents reduced from 2,000 volts to 60 volts by transformers; 2d, by direct currents reduced from 440 volts to 110 volts by accumulators used as transformers.

Mr. Crompton estimated that total cost of the generating station of the A. T. system at £29,040 and of the accumulator station at £21,500.

The cost of the alternating transformers is a very difficult matter to arrive at. The Grosvenor Gallery company, I believe, with few exceptions, supplies every consumer with his own transformer; but Mr. Kapp, in his recent paper, proposes to lay down a network of mains of much the same character as I use for the B. T. system, and to supply this network by a certain number of transformers, placed at frequent intervals in the network. It is difficult to see how any saving can be made by this arrangement. It will be noticed that, although it reduces the number of transformers, it introduces a new element of expense and difficulty, and that is, the providing of places to fix these large transformers. It may be that such places can easily be found, but my experience has been otherwise. It is not easy to find a place for any piece of machinery of a size between that which can conveniently be got into a surface-box placed in the pavement not exceeding one foot in depth by two feet square, and a sub-station of the size I require for my battery transformers. In most cases there is no space either under the footways or under the street itself to form a water-tight chamber of sufficient cubic capacity for the purpose. Another difficulty and cause of additional expense, which I think would tend to counterbalance any saving from the decreased number mains of transformers, would be that the charging laid *to* the transformers, and the distributing mains *away* from the transformers, would have to be laid in the same trench or culvert, and this would be no small source of danger to those at work connecting houses on to the distributing mains. As I have not been able to obtain any reliable data on this modified system of Mr, Kapps, I am obliged for the present to return to the system using one transformer for every two houses, and I think, for the reasons I have given above, the advocates of the A.T. system will not be able to make any great saving by adopting Mr. Kapp's suggestion.

Accumulators, to be used as transformers, must be of sufficient capacity to supply 200 kilowatts per hour for the hours during which the demand exceeds the 400 kilo-watts supplied by the dynamos. The load curves show that this period of maximum supply varies from about two hours in summer to four in winter. If I provide four groups of accumulators, each of which has a total capacity of 259 kilo-watts, or 1,000 kilo-watts for the four, I provide for five hours of extreme demand, which is a condition of things extremely unlikely to occur, even in times of a fog. In order to meet a case of possible interruptions to the charging current which might take place at the time of maximum demand, we require these accumulators to be capable of being discharged without damage to themselves, and at a fair rate of efficiency, at a rate not less than 650 kilo-watts. It is this latter requirement that has so long delayed the introduction of accumulators as transformers. Up to a recent date far too much attention has been paid to the capacity, and too little to the rate of possible maximum discharge. This state of things has lately been remedied, and I am told there are several makers of accumulators who can supply them to fulfil the above-mentioned conditions, and at the reasonable price named by me in my estimate. It must be remembered that such accidental stoppages of the lighting current as are likely to take place would not probably last for more than a few minutes — that is to say, if due provision has been made for spare machinery, and if the arrangements for working the machines parallel and interchangeable have been properly carried out. Time will not permit me in the course of this paper to describe fully the switch board and regulating arrangements necessary for the B.T. system. These require to be so arranged that the loss due to the difference of e.m.f. between the charge and discharge of the batteries may be as small as possible. It is quite possible to work the batteries parallel to the charging current during the hours of maximum demand with little or no loss from this cause, the loss being confined to the hours when the batteries are being finally filled up before the engines are stopped. The sub-stations, which contain the accumulator transformers, can in almost every case be placed on "mews" property ; and I have ascertained from accurate inquiry that there is no difficulty in obtaining accommodation for them in such property, with but few exceptions, within 300 yards radius of the houses to be supplied. In each case the sub-station consists of a battery-room and living-room for the man in charge. The plant in each sub-station consists of the batteries themselves, the regulating appliances above mentioned, voltmeters, and district meters as may be thought necessary.

Distribution.—In the case of the A. T. system the charging mains, as far as they lie within the area of supply, are in reality the distributing mains ; in other words, we require 20,000 yards of distributing mains to reach the houses. I am informed that the section usually employed for the distributing mains of these 2,000-volt circuits, when the transformers are placed in parallel, is 50 millimetres cross section, or 19 strand No. 15 B.W.G. This costs £71 7s. per 100 yards. I have not worked out the cost of so small a section laid on my own plan in the culverts, but it would certainly not be less than £96 per 100 yards. However, adopting the lower figure, the distributing main will cost £14,270. The writer in *Industries* says that 720 kilo-watts will have to be generated at the generating station for transmission to the area of supply ; dividing this by 2,000 volts, we get 360 amperes as the current in the charging main. Adopting Professor Forbes' tables for calculating the section of the conductor, we find that it ought to be about 645 millimetres, and if laid in the cable form, but without surface boxes, would cost about £308 per 100 yards, or in all, £6,160. It will be asked why I do not give to these charging mains the advantages of the somewhat lower cost of laying them as bare copper ; but I do not think it would be safe to leave conductors carrying currents at 2,000 volts thus unprotected in the culverts, as the risk to workmen employed on the district system would be too great, to which must be added the great risk to the consumers of making an accidental contact from the charging to the distributing mains. I should here remark that the very confident tone adopted by many supporters of the A.T. system rests on very slender foundations; they appear to forget that the great success obtained in America has been with overhead wires used as the primary or charging mains. We all know what a high degree of insulation is possible with overhead wires ; we also know that extreme difficulty has been met with in America in all attempts to obtain sufficient insulation for wires carrying currents of high e. m. f. when laid underground. As a matter of fact failure has been the rule, and success the exception. I believe that the difficulties of the A.T. system will commence when the contractors have to guarantee a perfect insulation with underground cables carrying currents at an e. m. f. of 2,000 volts. I think that I have not dwelt too strongly on the grave difficulties likely to be encountered by those who so glibly talk of laying underground charging mains, carrying currents at 2,000 volts potential, and I think that in all probability the additional precautions that will have to be taken to avoid failure of the insulation will be so expensive as to bring the total cost of the 22,000 yards up to practically the same sum as is required for the 2,000 yards of charging main and 20,000 yards of distributing mains of the B.T. system, for which no such special precautions are necessary.

I work out the cost of the latter as follows :—I use throughout bare copper mains of .25 inch section for the distributing mains—that is to say, for the 20,000 yards, £100 12s. 6d. per 100 yards, they will cost £20,125. The charging main will have to carry 910 amperes, and the extreme loss allowable being 8.25 per cent., its resistance must be .04 ohms. The double conductor will weigh about 45 tons ; this can be laid in brickwork, in cement culvert, at the rate of £306 17s. 6d. per 100 yards, or £6,137 10s. I have put down an item of £500 for the regulating gear for the A.T. system, and another one of £2,500 for the regulating gear for the B.T. system. The totals thus arrived at, and which you see before you on the wall, are £57,440 as the total cost of the A.T. system, and £59,762 for the B.T. system. These figures appear high; but I can not see how they can be reduced, unless under very exceptional circumstances. In both cases a very large portion of the cost lies in the distributing plant; and of this, the copper plays but an insignificant part, the real heavy charges being those inseparably connected with underground cables—viz., the cost of insulation and those connected with disturbing and replacing the surface of the streets.

Comparison of working and cost of maintenance; coal bill of the A.T. system.—The generating plant on the A.T. system has to run con-

[1] Abstract of a paper read by R. E. Crompton before the London Society of Telegraph Engineers and Electricians, April 12th.

tinuously—that is to say, the larger engines will be run for an average of three hours per day; and if it be found practically possible to subdivide the plant into a number of engines, and work them parallel, as is the case with the direct current system, we may be able to credit the engines and dynamos with an efficiency of 75 per cent. during these hours. In order to meet the average demand of 2,100 units per day, the load diagrams show that they will vary during these hours from 400 to 720 kilo-watts. We have as yet been furnished with no actual data as to the actual efficiency of the alternating transformer system at various rates of output, that is, the E.-H.-P. actually delivered to the lamps, divided by the E.-H.-P. at the terminals of the dynamos. It must be recollected that as the transformers must be large enough to supply the maximum demand of each house, whereas the maximum demand that the station can supply is probably not more than one-third of this, the transformers during this period of three hours can not be more than one-third loaded, and therefore it is not probable that their efficiency is more than 70 per cent. It follows that, during the hours when the plant is working at 500, 400, and 300 kilo-watts, the total efficiency —that is, E. H. P. delivered at the lamps, divided by the I. H. P. in the engine cylinders, including loss in mains—will not be above 54 per cent. Supposing that the steam engines can work at 2½ lb. of coal per I. H. P., the net quantity required per E. H. P. will be 4.65lb., or 6.2lb. per kilo-watt. The output during these hours may be considered as 60 per cent. of that of the whole day, or, say, 1,260 kilo-watts; therefore about 70cwt. will be used during these three hours. During the remainder of the 21 hours the transformers will be working at a very small rate of output. It is probable that their efficiency will be reduced to 30 per cent., and the efficiency of the steam engines and dynamos to 50 per cent., or a total efficiency—that is, E. H. P. at the lamps, divided by the I. H. P. of the engines—of 15 per cent. only; therefore, during this period it seems probable that 17lb. of coal will be used per E. H. P. or 22 5 per kilo-watt. Therefore, the coal used in producing the balance of the daily output of 840 kilo-watts will be about 8 tons 8 cwt., or, making a small allowance for the lighting up of boilers, 12 tons per day. The oil, water, and petty stores may be calculated at 7s. 6d. per hour for three hours during the day, and at 1s. per hour during the remainder of the time. Therefore, the total cost of material used in running this station will be £4,849. The B.T. system, on the other hand, will show great saving on this. For the output of 2,100 units it will be sufficient to work the generating plant for about five hours at approximately its greatest rate of efficiency. I have had ample experience with this class of plant, and know that we can in actual practice produce the E. H. P. at the terminals of the dynamo with the expenditure of 3½lb. of coal. Taking the maximum loss in the accumulators, the efficiency of the system—that is, the E. H. P. at the lamps, divided by E. H. P. at the terminals of the dynamo—will be not less than 80 per cent.; therefore, we may say that each unit at the lamps can be produced for 5.75lb. of coal, or 5 tons 8 cwt. per day, or allowing a 25 per cent. margin for contingencies, 2,550 tons per annum. The water and petty stores may in this case be taken at 5s. an hour for 1,400 hours; the total cost of the material for producing 2,100 units by the B. T. system will be £2,517, or only about 57 per cent. of the cost of material by the A.T. system. Turning now to the labor in the engine room, the table before you shows that, as in the case of the A.T. system, the hours are continuous; three shifts of men will be required: it is necessary to have two foremen, six engine drivers, and nine firemen, whereas in the B.T. system there is only one shift of men: one foreman, four drivers, and three firemen are employed. I have only estimated for two extra men in the engine room for the A.T. system, but for the B.T. system I have allowed for four accumulator foremen in charge of the four accumulator stations, and two messengers. The totals thus arrived at for labor for working the systems are £1,389 8s. 8d. for the A.T. system and £975 for the B.T. system. The salaries are £1,200 for the A.T. and £1,020 for the B.T. system. The last item we come to is one for repair and renewals. In both cases I have allowed at the rate of 10 per cent. on the motive power of engines and dynamos, 5 per cent. on the buildings and fittings, 10 per cent. on transformers, 15 per cent. on accumulators, 7½ per cent. on the insulated mains that have to carry 2,000 volts, 2½ per cent. only on the bare copper mains (the majority of which only have to carry 110 volts) 10 per cent. on all regulating appliances. Thus nearly the heaviest item, the maintenance, comes to £4,683 5s. in the A.T. system, and £4,086 10s. for the B.T. system. The gross cost of producing 776,500 units by the A.T. system would be £11,939 13s., and the B.T. system would be £8,598 10s. or 3.75 and 2.7 per unit respectively. In order to make a fair comparison between the two plants when worked in the most economical manner, if the generating station of the B.T. system is worked longer hours it can actually produce the daily average of 3,600 units named by the writer in *Industries*; in order to do this the sole increase in the working expenses would be in the materials, to which £1,800 would have to be added. The cost, then, of 1,314,000 units would be £10,398 10s., or 1.9 per unit by the B.T. system.

It will be seen, therefore, that while by both systems there is a probability of a fair return on the capital expenditure, yet in almost every respect the B.T. system is a more economical one. This arises from the fact that the main cause of expense in the A.T. system, depending, as it does, on continually moving machinery, is the heavy cost of material, labor, and superintendence during the long hours in which the machinery is working very lightly loaded. The B.T. system shows very favorably in this respect, as even at the latter increased output of 3,600 units per day the machinery need not work, on the average, more than ten hours, so that one shift of men can do the work, and there is ample time for repair and inspection of the machinery.

Electric Facetiæ.

Spare the rod and spoil the church.

Song of the cable. "Put me in my little bed."

Hello! hello! that almost worn out word;
So loudly spoken, and so faintly heard.
Yet all that hope suggests, or grief can know,
Lies in that well-known little word, Hello.

Professor John L. Sullivan, of Boston, affirms that judging from tests made on others by himself, the resistance of the human body is very slight.

One man can shake out a cross, and another can pile on the agonies until the hearer longs for an escape, but occasionally we locate a fellow who can do many things well. One writer believes in condensation, while another may like to "pad". It is seldom, however, that anyone has beaten the record of the poet who gave us in four lines much valuable information concerning land lines, ocean cables, and measurements. He disposed of the various subjects in this admirable way:

"Were I so tall to reach the pole,
Or grasp the ocean with my span;
I must be measured by my soul,
The mind's the standard of the man."

A Georgia Skeptic.

A Washington letter has this story of the introduction of the telegraph into Georgia: There was a bill before the Georgia Legislature to grant certain privileges to the telegraph company. There was considerable opposition to it. One skeptical old mountaineer in particular was fighting it upon the ground that the whole thing was a fraud. There was no use telling him that anybody could send things through the air on wires.

"But," said Ben Hill, holding up a newspaper, "here is proof of it. Here is a newspaper with items in it about things that happened hundreds of miles away the same day."

"O, that's good enough to tell. How do you know the items ever happened? Who's here that saw them? What's items good for, anyhow? You may pass this bill if you want to, but I want it put down right here that I wasn't fooled, and just put it down, Mr. Clerk, that I said at the time boldly denyin' contradiction, that Mr. Hill would never see a bale of cotton jerked through the air on his new-fangled concern as long as he lived."

CORRESPONDENCE.

St. Paul's Progressiveness.

ST. PAUL, Minn. April 28.—The amount of building already under way in St. Paul is astonishing in its extent and would be incredible to one not accustomed to the push and energy characteristic of the northwest. In addition to the buildings and improvements now under way, those which are contemplated and are assured facts, will place St. Paul in the front rank of cities aspiring for the laurel wreath of enterprise and progressiveness, notwithstanding the fact that St. Paul must need crowd her material improvements into the late spring, summer, and early fall months. The gratifying outlook causes the electrical fraternity generally to rejoice, for it means an era of activity in all branches of electrical industry. The territory adjacent and tributary to St. Paul is also furnishing its quota of business as evidenced by the work being done in Minnesota, North Wisconsin and Dakota by St. Paul business men.

Miles & Hale, electrical supplies, bells and annunciators, report business in their line good. They have the contract for fitting up the new 100-room hotel at West Superior with the new combined system comprising hotel annunciator, guest call and fire alarm. They are also putting in a similar system in the new hotel at Pipestone, Minn.

The American District Telegraph company are perfecting the details of a new register system. Applications for patents are now in and in a short time their important improvements in this line will be ready for service. Fuller details of this system will be watched for. The general superintendent of this company, B. G. Yates, reports business on a satisfactory and prosperous footing and the outlook so encouraging that they contemplate making extensive additions to their present facilities. They are extending their house lines considerably and are about putting up 15 to 20 miles of circuit to accommodate the rapidly increasing demand for the miscellaneous service in their line. They have recently fitted the People's bank with the Holmes electric protection system, and are estimating on the extension of the same system to the new Plymouth Clothing house.

The Economy Steam Heat company of this city, who are in the field for station work with incandescent and arc lighting as well as steam heating, have recently had their plant overhauled by T. P. Benton & Son, mechanical and electrical engineers. The company are operating arc lights of the Western Electric company's manufacture, for general commercial lighting. Two 30-light dynamos are now in use carrying their full number of lights. About 1,500 incandescent lights of the United States Electric Lighting company's system are operated by the same company. The Grand opera house is lighted throughout from this plant, as well as some of the best office buildings in the city, notably the Court, Grand, Union and Davidson blocks. This, with the regular commercial work being done, taxes the capacity of the plant to its utmost. The services of Benton & Son were secured for the purpose of rearranging the plant with the object of making an early increase of lighting capacity and the addition of an electric motor circuit.

C. W. Scribner, representing the interests of the Daft Electric Light and Motor company, has made St. Paul his headquarters for some time and is not at all averse to remaining longer in the promising northwest. His company is installing an important incandescent station for street and general commercial lighting at West Superior, Wis. The establishment of a branch office of the Daft company in St. Paul is one of the possibilities of the near future. A move of this sort would be to the advantage of the Daft company as they would then be represented at an important commercial center where other light and power companies have permanent representation. Mr. Scribner is a graduate of Stevens institute, a high authority upon the electric motor subject, and a valuable acquisition to the electrical community of St. Paul.

J. H. Woolsey, representing the United States Electric Lighting company in St. Paul, reports the prospects excellent for a large business during the coming season. Estimates are being prepared for new work at Duluth, Lake Minnetonka, Excelsior, Minneapolis and other places. This, with the preliminary work being done at numerous other points, keeps Mr. Woolsey in a continuous but agreeable, round of business activity. H. B. Warren, superintendent of erection for the same company, has just returned from a brief visit to Chicago, taken with the view of increasing facilities for work in his department. Mr. Warren at present has work in progress at several points in this immediate vicinity and at Duluth and is also making preparations for starting work on several new installations of considerable magnitude.

The case of the poor fellow who was killed here a few days since by coming into too intimate relations with the

current of a Thomson-Houston dynamo, is another example of indifference to danger engendered by long familiarity in handling powerful forces. The unfortunate man was undoubtedly not as careful as he should have been and received a shock which primarily was the cause of his death. Whether the effects of the current alone were sufficient to cause his death, or whether his fall from the pole to the pavement produced the fatal results, will never be known. Accidents of this nature are not becoming as rare as the community at large could desire. W.

Minneapolis Mention.

MINNEAPOLIS, April 28.—All branches of electrical industry in Minneapolis are in an exceedingly flourishing condition. There is an active demand for electrical supplies, bell and annunciator work, isolated lighting plants, and President Cleveland's famous characterization of the state of the republican party is not at all applicable to the business of the local Brush company's station.

Bell & Co. carry an extensive line of electric goods and line materials, and are doing a very prosperous business. They are a progressive concern, constantly watching for and availing themselves all opportunities for extending their line of goods and facilities for meeting the multitudinous demands of the trade. At present they have a virtual corner of the battery business, having bought in all the jars in Minneapolis.

Arthur S. Huey, Manager for the Edison company for the northwest, is in the best of spirits. He states his company is securing and doing the cream of the incandescent lighting of this section of the country. A few days since Mr. Huey closed a contract for installing a plant in the new Donaldson glass block, Minneapolis. The plant will consist of a 400 lamp Edison outfit and a 70 arc light apparatus of the American system. The competition for this job was of the most spirited kind and Mr. Huey is correspondingly exultant over his victory. Mr. Huey states that the lamps at the People's theater are giving an average lifetime of 1,800 hours and 12¼ lamps to the horse power.

The Edison plant recently installed is Segelbaum's dry good store, is running beautifully. Mr. Segelbaum was so pleased with the plant that he gave his check for the work upon the first trial of the lights. As a souvenir, Mr. Huey exhibits at his office a 32 candle power lamp taken from Pillsbury "A" mill. This lamp was used for over two years in testing flour and had a lifetime of between 6,000 and 7,000 hours.

S. S. Leonard, general manager of the local Brush company, is a busy gentleman, but very courteously took time to show your correspondent the magnificent Minneapolis station operated by his company. This station is one of the finest in arrangement and facilities, as well as one of the largest to be found any where in the country. A detailed account of the many novel and economic features of the Minneapolis Brush station will be of interest to the readers of the WESTERN ELECTRICIAN and may be looked for in a succeeding issue. Mr. Leonard reports the demand for all kinds of service as generally good for this season of the year. Every day adds to his list of consumers for arc, incandescent and motor service.

The Benton Electric Manufacturing company of Minneapolis, on April 26th, filed articles of incorporation with the secretary of state; capital stock $10,000; the incorporators are Thomas P. Benton, of LaCross, Wis.; W. F. Benton, G. F. Westcott and T. W. Stahler, all of Minneapolis. H.

From Kansas City.

KANSAS CITY, April 28.—Your correspondent at the invitation of G. M. Meyer, general manager of the Home Telegraph company, to-day inspected the elegant new quarters of the company. The growth of the organization since its incorporation is remarkable. Having started in 1883 with a few subscribers it has steadily increased until at the present time it has upwards of 1,100 subscribers in the messenger service and over 300 watch signal boxes. The company is also running lines and placing boxes for the Mooney & Boland patrol force. On the left as one enters the new quarters at 123 West Sixth street, are noticed the switchboards of the Bunnell make, for the Holmes burglar alarm system, watch signals and messenger calls. This department is under the supervision of W. N. Hayes, who is almost a prisoner behind his bronze wire and cherry counters. Across the spacious room an elevated platform containing chairs for the seventy-five messenger boys employed by the company. As each messenger comes in from a call he takes a seat at the lower end of the room so that all do an equal amount of work. On the right is the private office of the assistant general manager G. W. Conover, who since Mr. Hughes' resignation is doubly loaded with business. In the lower end of the room are the lockers for the boys, also wash-room, closets, etc. Large and spacious as the new offices are, still if this company's growth is as large the coming year as in the past one they will be obliged to seek larger quarters.

The Inter-State Electric company has just finished wiring the Adams House for the accumulator system. Sixty-six cells will be used. The plant will be in operation in a few days.

The Gas Light company at Boonville, Mo., is contemplating a system of electric light for that city. The system to be used has not as yet been decided on.

The Kansas City Electrical Works are now placing in the Railway Hospital at Ottawa Kansas, a complete system of calls from each cot and ward for use in calling matron, physician and nurse. This is one of the largest and most complete hospitals in the west.

C. H. Cone, selling agent of the Electrical Supply Co., will remove to his new quarters in the National Bank building the first of next week. D.

Nebraska Notes.

OMAHA, Neb. April 28.—The United States Electric Lighting company, by Mr. Frank Warren of this city, has just installed a 400 light plant at Norfolk, Neb. The same company recently installed 50 lights in a large flouring mill of this city. The Omaha Illuminating company using this system, reports business good and running nearly full capacity.

The Thomson-Houston Electric Light company of this city recently made a contract with one of the large hotels for one hundred incandescent lights.

In the smaller towns of this state where the electric light has been introduced, the reports of their success is most flattering, notably at Seward, with the Westinghouse, at North Platte with the Sperry, at Kearney with the Thomson-Houston, at Wahoo with the Thomson-Houston, where with a population of 2,200, over 400 incandescent lights are in use.

A report comes from Kearney, that during a recent storm, lightning struck the lines of the Nebraska Telephone company about three blocks from the central office, and midway between two poles burning off every wire at that point, some twenty-three in all. No other damage was done.

The Nebraska Telephone company report a steady increase in its list of subscribers. A force of men has been kept steadily at work repairing the damage done by the recent sleet storms, and the lines are once more in good shape.

The headquarters of Geo. Albree, special agent of the American Bell Telephone company, have been removed from Denver to Omaha and his jurisdiction is extended so that it now covers the Nebraska Telephone company, the Iowa Union Telephone company, the Rocky Mountain Bell Telephone company, the Colorado Telephone company, and the Northwestern Erie Telephone company.

The Clay County Telephone company, which was organized some time ago to use the Cushman instruments, and was doing considerable business, has come into the fold, and has offered to exchange its instruments for those of the Bell company. Their lines already constructed will hereafter be operated in connection with those of the Nebraska Telephone company.

No suits for infringement had been instituted by the American Bell Telephone company against this company, and it is presumed the recent decision of the Supreme court was a "clincher," and this action was taken to avoid legal proceedings.

Efforts to establish exchanges at Kearney, Holdredge, Broken Bow, and other points in this state, have failed, by reason of the representations made to the proposed projectors by the local Bell interests, and the Supreme court decision.

The council at Beatrice, Neb., is discussing an ordinance to compel the removal of all telegraph, telephone, electric light wire and poles from the streets to alleys. The Western Union Telephone company has just completed a handsome and substantial line of 45-foot poles, and there are over 165 telephone subscribers at that place. The passage of the ordinance is hardly probable.

W. W. Low of the Central Electric Co., and C. H. Cone, of the Electrical Supply Co., were recent visitors to our city. W.

From the Pacific Slope.

SAN FRANCISCO, April 24.—The British surveying ship Egeria will be at New Zealand next month and will immediately commence the work of surveying for the Pacific cable. The course will be from New Zealand to Tongo, to the Sandwich Islands to Vancouver. It is thought that three years will be required in the work.

C. R. Lloyd has resigned the agency of the Jenney Electric company on the Pacific coast and has accepted the position of contracting agent of the California Electric Light company which operates the Brush and Thomson-Houston systems.

George L. Henzel has resigned as manager of the Napa Electric Light company.

The Pacific Electric Motor company has extended its circuits to 26th St.

The Thomson-Houston system is to be installed at Eureka.

The "Dynamo Tenders' Hand-Book" is on sale at the California Electrical Works, 35 Market St. S.

Kansas Notes.

LAWRENCE, Kan., April 27—This city will soon be one of the best lighted cities in Kansas. A new electric light company has decided to purchase a $30,000 Thomson-Houston plant. The company will build a station and equip it with two engines of 200 horse power each. Seventy arc and 1,000 incandescent lights will be furnished.

The citizens of Winfield have offered A. J. Reams, inventor of the Reams Electric clock a donation of $25,000 cash and ten acres of land to locate and manufacture his clocks in that city. The directors of the company, which has a capital of $100,000, are: J. J. Carson J E. McCulley, J. C. Hoyt, A. W. Florea, A. M. Burdett and J. A. Wiedemann. The clock is simple in its construction, durable and reliable. The motor is electricity, and it will run one year without re-charging the battery. Wires can be run from the clock to any number of rooms in a building and the clock can be set to indicate the time in all the rooms, and ring a bell in any room at any moment, day or night, as desired. A hotel clerk can set the clock to call a guest at any hour in less time than he can possibly write the guest's name. The beauty of it is that the clock never fails. It is destined to become invaluable to public schools hotels, railroad offices, etc. Mr. Reams had with him certificates from the principal and officers of the Augu ta public schools, stating that his clock had been in use in the public schools at that place for fourteen months, and had given great satisfaction. The building has seven rooms and 140 ca ls per day have been made and the clock has never had any attention.

An electric light company will be organized at Wichita with a capital stock of $100,000. Enough stock has been taken to warrant the assertion that the enterprise is certain to be started. The station will consist of four boilers with 400 horse power, four engines of 300 horse power and dynamos sufficient to supply 4,000 lights. The entire plant, it is estimated, will cost not less than $75,000.

Wellington has two electric light plants, the Excelsior and Thomson-Houston systems, furnishing for a small monthly consideration arc lights of 2,200 candle power.

The Atchison Gas, Electric Light and Power company has been organized. The capital stock is $300,000. The directors are: J. P. Pomeroy, of Boston, Mass.; A. G. Otis, I. P. Brown, E. S. Mills, J. M. Chisham.

The Russell Electric Light and Power company has been incorporated with a capital stock of $10,000. The directors are: J. M. Brandage, S. E. Lawson, W. H. Moses, A. T. Brooks, Chas A. Wolcott and J. H. Hill, of Russell.

Mr. Kapp, of Peabody, expects to start the Florence electric light in a few days, and if nothing happens to change his plans will also put in lights in Peabody about June 1st, with storage batteries.

The plant of the Salina Electric Light and Power company is to be enlarged.

It is believed that the city of Topeka Electric Light works, an installation in charge of the Jenney Electric company, will be in running order by June 11th. McD.

Indianapolis Items.

INDIANAPOLIS, Ind., April 28.—The Jenney Electric company, of this city, report a very satisfactory business, having supplied 78 complete electric light plants in the last year, and although working 130 men are unable to keep up with their orders. During the past week they have received the following orders: Three machines and electrical apparatus for the Richmond, Indiana, Gas Co.; two incandescent and one arc light machine for Catlettsburg, Ky; a 30-light arc outfit for Sullivan, Indiana; a 50 light machine and lamps, additional order for San Bernardino, Cal; also an additional order from San Diego, Cal., for several towers, besides several small orders for incandescent apparatus. This company was the successful bidder for lighting the new Union passenger station and train sheds which have already been wired. Work on this plant, which consists of 1,100 incandescent and 70 arc lights is going forward rapidly, and will be completed as soon as the building is ready to receive it.

The Indianapolis *Daily Sentinel* company has not yet decided what system of electric light they will use in their building.

The Indianapolis Brush Electric Lighting company have taken down their 125 foot tower, erected in the circle three years ago, to make way for the soldiers monument which is to be erected there. The lamps on this tower were not lighted more than half a dozen nights during the time it was standing.

Several electric lighting companies are preparing bids for lighting the city, and with the prospect of three competing natural gas companies furnishing fuel, there is no reason why Indianapolis should not be one of the best as well as the most cheaply lighted cities in the country.

After thirty-six hours' deliberation, the jury in the case of Catherine Kelly against the Brush Electric Light company, of Lafayette, Ind., returned a verdict of $1,300. The plaintiff claimed permanent injury from falling over a coil of wire on the street. She asked $10,000, M.

Ottawa, Ill., and Vicinity.

OTTAWA, ILL., April 28.—The new Edison station recently installed for the Peru Electric Light and Water company, Peru, Ill., is so crowded with orders that the 450 lights are all taken and the plant is to be doubled in capacity; sixty-four 32 candle power lamps furnish light for the city.

The United States people have put in a plant at LaSalle for incandescent lighting, but have failed to make much headway as yet. LaSalle and Peru are rival cities, the city limits of the two places joining.

The Ottawa Window Glass company have just completed the installation of a hundred light incandescent plant in their factory at Ottawa, Ill., and the Pioneer Fire-proof Construction company have almost completed the installation of a 215 light plant at their factory, both are of the United States system.

Mayor Matthiessen, with the fire committee of the LaSalle council, is looking into the cause of the electric light wires becoming crossed with the fire alarm wires, and an ordinance requiring better construction is now under consideration.

The Central Union Telephone company are rebuilding the exchange at Streator, Ill., using fifty foot poles. The exchange will be moved to new and more commodious quarters in the Opera house block; when the work has been completed the exchange will be in better condition than ever before. The exchange is under the management of Thomas Brown, late of Galesburg, Ill.

The more important toll stations of the Central Union company are being supplied with the new long distance transmitters. This improvement will afford a wide range of business. It is a frequent occurrence for a communication to be had between Ottawa, Ill., and Madison, Wis., via Chicago and Milwaukee, making a circuit of 270 miles. The long distance transmitters are used.

The Wheatstone circuit of the Western Union company between Chicago and Omaha that is strung along the C. R. I. & P. R.R. Co.'s track, is causing considerable disturbance to the telephone lines both east and west of Ottawa, and arrangements are under way to move the telephone line of poles between Ottawa and LaSalle for a distance of sixteen miles. The telephone company has important business between these two points which must be cared for.

There is no effort being made in Wenona, Lostant and Tonica to have a telephone line built connecting these points with the Central Union system at LaSalle.

White's Hotel at Ottawa is being wired for one of the Western Electric company's needle hotel annunciators.

The Thomas Electric Light and Power company, of Ottawa, are running their plant up to its full capacity having more orders for lamps than their four dynamos will carry.

The Spring Valley Coal company of Spring Valley, Ill., have just had one of their mines equipped with an incandescent light plant as an experiment; your correspondent is not advised what system they are using. E.

Detroit's Budget.

DETROIT, MICH., April 28.—Two petitions are before the council asking the privilege of constructing and operating electric street railways in this city. There is a demand for a better service than is now provided by the existing companies, and the flattering success which has attended the operation of the Highland Park electric railway will probably induce the council to grant the franchises desired.

An important case as far as relates to the liability of employers, was tried here last week. Almeron Kraatz, while trimming lamps on a tower in August, 1886, sustained injuries amounting to total disability for work. He sued the Brush company for $25,000 damages, and was awarded $10,000. The testimony showed that Kraatz climbed the tower and worked for a while on the lamps. He was then seen to come down slowly and stretched himself on the ground. Kraatz claimed to have received a shock from one of the wires used for night lighting, and which was supposed to be dead. The company denied that the wires were charged, and claimed Kraatz's injuries were due to sunstroke. Judge Brevoort, before whom the case was tried, held that the company were under no obligation to say in just what manner Kraatz was hurt, or to present even a plausible theory. Among the requests from the company's counsel—ex-Judge Marston and J. T. Cowles—which the court allowed, was: "There is no evidence in this case tending to show that the defendant failed to exercise due and proper caution in the selection of its employes. There is evidence in this case to show that the business in which the plaintiff was engaged was dangerous and that he knew it was. The law in such cases declares that the employe takes upon himself the ordinary risks of the employment, and if in the performance of his duties and without the fault of his employer he receives an injury, he cannot recover."

Another employe was awarded $750 damages for injuries sustained through the breaking of a tower elevator. An appeal will be taken.

The Detroit Electrical Works have been awarded the contract for building the Sault Ste. Marie electric railway. The contract price is $35,000. Two miles of road are to be in operation by July 1st.

The Edison company plant at the "Soo" is completed and business will be begun immediately. An attempt will be made to utilize the water power of the rapids.

The output of copper during March from Lake Superior mines was:

	TONS.
Calumet and Hecla	2,289
Tamarack	643
Osceola	210
Franklin	181
Atlantic	257
Huron	124
	C.

THE ELECTRIC LIGHT.

Madison, Wis., will soon be lighted by electric lights.

The Joliet, Ill., Electric Light company has been incorporated; capital $50,000.

The question of electric lights for Wakefield Mass., will be discussed at the next town meeting.

It cost to light the British house of commons last year £3,300 for gas and £480 for electricity.

The incandescent electric light plant to be erected at Decatur, Ala., will have a capacity of 2,000 lights.

The Thomson-Houston company has completed its first installation in Paris on the Boulevard des Capucines.

The new Y. M. C. A. building at Rockford, Ill., which will cost $60,000 will be lighted throughout by incandescent lights.

The United States cruiser Chicago has been fitted with 428 incandescent lamps. The officers are enthusiastic over the installation.

The improvements contemplated by the Paris, Tex., Gas and Electric Light company will cost $25,000. A Westinghouse incandescent plant will be added.

It is stated in the annual report of the insurance commissioners of Massachusetts that out of 2238 fires which occurred in that state last year only 14 were attributable to electric light.

The Western Electric company of Chicago has received the contract for installing a 60 light plant at Dunkirk, N. Y. The plant will be owned by the city. The contract includes both the circuits and steam plant.

The Bristol, England, cathedral is to be illuminated by electric light. When the building was lighted by rows of gas jets at the time of the Queen's jubilee the heat was so intense that many of the members of the choir were obliged to retire.

The Yorktown, the new government cruiser, which was launched April 28th, has a complete electric light plant with two sets of dynamos. Telegraphic facilities are arranged so that the officers in command can communicate with those below.

The following dispatch was sent from Boston April 26th: The Atlantic Machine works at East Boston were burned this morning, entailing a loss of $150,000. The fire originated in one of the pattern rooms and is supposed to have been caused by the wires of an arc electric light.

The building to be occupied by Wanamaker & Brown, at the corner of Adams and State streets, Chicago, will be illuminated by thirty-five arc lights which will be installed by the Thomson-Houston company. The same company will install 500 incandescent lights at the Panoplicum building, Chicago.

Charles Marks, electrician of the Kokomo, Ind., Electric Light works, was shot by Thomas Ruse last week and died from the wound on Thursday. The murdered man formerly lived at Crawfordsville and Peru, coming from the former city in December. He leaves a wife and two children, a child of 18 months and a babe of 6 weeks.

Frederick Witte, bookkeeper at Schlessinger's tailor store in New York, was instantly killed April 27th, while endeavoring to regulate an arc lamp in front of the store. In spite of the fact that he had been repeatedly warned by the electric light company to send word to the office if trouble was experienced with the lights, Witte insisted on experimenting with them.

The Springfield, Mass., gas light company has absorbed the plant of the Westfield electric light plant and will considerably enlarge its capacity for supplying electricity for illuminating purposes The present electrical building on Orange street will be given up, and a brick building, 40 x 100 feet, will be erected near the gas house, giving room for dynamos and boilers that will run four times the number of arc and incandescent lamps now in use.

The building of the St. Louis *Post-Dispatch* is lighted by an Edison electric plant with a dynamo 300 16-candle power lamp capacity, and the feeders and mains of the wiring system are proportioned for 600 16-candle power lamps, thus providing amply for the expected increase to 500 lamps of the same candle power, or 400 of 20-candle power. The dynamo weighs 2,880 pounds and occupies a floor space in the press-room of 66 by 50 inches, and makes 1,400 revolutions per minute.

A dispatch says:—The Pennock Battery electric light office, at 110 South Third street, was the scene to-day of a successful experiment. A single incandescent electric lamp illuminated the entire office, shedding a clear, strong light that brilliantly lighted the room. The light was arranged according to the Pennock method and equalled four gas-lights of 16-candle power each. The feature of the lamp is that the electric current which supplies the light comes from a primary battery rigged with Pennock's automatic electric current feeder to give forth a steady current of electricity as long as the light is wanted.

The following dispatch was sent from St. Paul last week: James Roberts, of the St. Paul Gas Light company was killed by an electric shock. He went up a pole at the corner of Jackson and Seventh streets to operate a "jumper," to turn on an electric light at Jackson street rink, three blocks away. Taking hold of the wire with a pair of insulated pincers, he started to make the switch but his foot slipped and he dropped the pincers and grasped the wire with both hands. He was paralyzed by the shock, fell back into the mesh of wires and hung feet downward for several minutes. He was taken down as soon as possible, but life was extinct

The licenses which the New England Electric exchange will grant will be divided into five classes. First class, to install and operate any electric light and electric power plant. Second class, to install and operate any two of the following plants, viz., incandescent light, arc light, or power Third class, to install and operate any one of the following plants, viz. incandescent light, arc light, or power. Fourth class, to operate electric machinery, but not to do electric wiring. Fifth class, to do electric wiring but not to operate electric machinery. The New England underwriters have expressed their willingness to co-operate with the electric light men in licensing employees.

For the last six weeks somebody has been cutting down and stealing electric light copper wire all over the city, says a dispatch from New York. One night last week all the wire for six blocks on the Bowery was cut down and carried off. A few days ago 1,500 feet was taken from Seventh avenue. Various other depredations of an exactly similar character were reported. Three of the electric light companies appealed to Inspector Byrnes for protection. Edward Paul was discovered delivering an express wagon load of copper wire at a junk shop. Edward is now in jail waiting examination. It is believed that he is the original discoverer of this form of theft, or at least that he is the first who has been daring enough to attempt it.

THE ELECTRIC MOTOR.

An exchange says: The tendency toward electricity, as a motive power is very emphatic, both for the propulsion of machinery and for locomotive purposes, and it is safe to predict that the domain of the steam engine will be seriously curtailed in the near future not as to the gross horse power because dynamos will be mostly driven by steam, but small engines will be superseded by electric motors.

The St. Louis *Globe-Democrat* says: Jerry Fruin's battery for the electric street car motor is in a state of statu quo. The Hollhausen Motor company, of New York, with whose motor Mr. Fruin was experimenting, say they expect to complete their motor and make it perfect in a short time, so the Fruin battery will not be tested again until the Hollhausen motor is in a state of absolute perfection.

The estimated cost of the proposed electric road of Paris which is a little more than 16 kilometers in length, is £2,160,000, an average of £129,400 per kilometer. The Bois de Boulogne line may, it is said, be finished in time for the great exhibition of next year. It is proposed to run, if the traffic requires it, a car every minute, an interval of time amply sufficient to insure safety with the arrangements to be adopted.

The San Jose, Cal., electric road is not yet in operation. It has been impossible thus far to secure the necessary power. Mr. Bishop, who is interested in the road said: "The machinery is here, and we have not yet been informed as to whether it comes up to the test or not. I can say we have used every endeavor to complete the road as soon as possible, and we believe that it will soon be in successful operation."

A look into the Eighty-fifth street stables of the Fourth and Madison avenue surface road gives indications that some one is very much in earnest in the determination to make the electric motor go. About one-fourth of the building has been appropriated to the operations of the Julien company, and there are masons and machinists at work on the ground floor putting up steam boilers and machinery. There are also draughtsmen and designers in the second story, all earnestly engaged upon the plans that are intended soon to banish horses and confine steam to the work of turning a dynamo. The dynamo itself is already at work,

and two long tables on the ground floor are covered with accumulators undergoing the charging process The exhibition car which has been seen upon the road during many months past has been taking a rest recently while workmen were engaged in making alterations to lighten it and improve its running qualities. It was started again yesterday afternoon much improved, it is said. The superintendent is reticent in making promises concerning the time when the first ten cars which have been ordered will be put upon the road, but they are expected to be ready soon. The capacity of the charging room, now in preparation at Eighty-fourth street, will be equal to the supply of accumulators for twenty cars. If the performance of this number of cars is found satisfactory after they have been equipped, the main stables on Fourth avenue will be taken for the location of the dynamos as the more central and convenient point.—New York *Sun*.

THE TELEGRAPH.

Senator Romero, the Mexican Minister, recently said to a reporter: "About two-thirds of our 13 000 miles of telegraph line is owned by the government, and these lines have been largely constructed by government aid. We have a very fair telegraph system, though our rates are, I think, high."

The constitutionality of the Subway acts, imposing assessments on the telegraph companies, is now under consideration by Judge Barrett, of the Supreme court in New York. The Postal, the United Lines and the Commercial companies have applied for injunctions to restrain the collection of assessment under these acts.

At a meeting held in the Western Union building in New York last week the Magnetic club was organized and the following were elected officers and members of the governing committee: President, Charles P. Bruch; Vice-Presidents, Wm. J. Dealy, Gardner Irving, Wm. L. Ives and Lant S Jones; Secretary, George F. Fagan; Treasurer, John Brandt. Governing Committee—J. B Taltavall, D. W. McAneeny, W. H. Baker, J. M. Moffatt, E. F. Howell, E. F. Cummings, C. Myer and T. A. Brooks. The club is purely a social one, only those connected with electrical pursuits being eligible to membership.

The Postal Telegraph company has moved into its new quarters in the Phœnix Building corner of Clark and Jackson streets, Chicago. The work of moving was attended with no little difficulty but was successfully accomplished in a short time. The work was commenced Saturday night after the day business had been completed. Those wires which were not needed in the night were disconnected and connections from the wires in the new office were made at the nearest conduit. The newspapers loops of course could not be touched till the papers had gone to press. The offices are probably the handsomest quarters occupied by a telegraph company in the city.

"The telegraph companies take a great deal of pains to keep their messages secret, but induction gets the better of all their safeguards," said an electrician in a South-side office to a Chicago *Times* reporter. "I have often stood at the telephone here and read messages sent over Western Union wires. In dry weather the induction is not great, but during damp spells the characters are as distinct as though the operator was only a few feet away. Of course the message can be heard even then only when our telephone wire runs along with the telegraph wires. The clearest message I ever got this way was the day Charlie Farwell was elected senator. I was at the telephone talking to a friend when the words broke in on us, 'C. B. Farwell elected senator.' I had my information half an hour before the evening paper 'extras' gave it to the rest of the town. If you listen now you can hear somebody calling up 'C H.'"

THE TELEPHONE.

Following is a dispatch from Fayetteville, Ark : The recent decisions in the Bell Telephone suits, both in the Supreme Court of the United States and in the State courts, has had the effect of causing some uneasiness here on account of the Pan Electric system. The local exchange was ordered to discontinue and take down its boxes, but has so far refused to do so.

In New Orleans, April 28th, Judge Pardee, of the United States Circuit court, handed down a decision in the case of the American Bell Telephone company et al against the National Improved Telephone company, in equity. The court decides that the telephones used by the defendants are infringements on the Bell patents and orders that all such instruments be delivered to the clerk of the court, subject to further orders, and gives the complainants judgment against the defendants for all costs, charges and disbursements in this suit. William Grant is appointed master to ascertain costs and damages.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks :

Chicago	375	400
Central Union	47	48
Michigan	78	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	70	72

Personal Paragraphs.

General Manager Godfrey of the New York Insulated Wire company, has been in the west for a week, looking after the business of his company.

Dr. Robert Amory, of Boston, has purchased the interest of Edward H. Goff in the American Electric Manufacturing company, and will shortly succeed Mr. Goff as president and general manager of the company. Dr. Amory has been the manager of the New England department of this company Mr. Goff retires chiefly in order to devote his energies to the conduct of the New York *Graphic* which paper he recently purchased.

Miscellaneous Items.

The *Statist* predicts that the rise in the price of copper will almost certainly lead to the substitution of copper coated iron for various purposes.

A certificate has been filed at Springfield, recording the reduction of the capital stock of the Chicago Sectional Electric Underground company from $2,000,000 to $300,000.

One of the great gas companies in Philadelphia confesses to being able to make fuel gas at a cost of 16 cents per thousand cubic feet, in the holder ready for distribution, by the use of a bench of coal retorts in connection with water-gas generators, such as are in use at the Krupp works in Essen, Prussia.

It is said that the congressional reporters will use Edison's graphophone. When one of the principal stenographers concludes his floor report he goes to this machine, reads his report into a funnel. When he has finished reading another operator attaches tubes to the cylinder, connecting with his ears, works the machine, and the words of the stenographer are repeated to him in the same tone of voice as the previous talker. The rapidity of the talk can be regulated, and the operator can thus with ease take down the exact words by the use of a typewriter or an ordinary pen.

The Belgian Society of Electricians offers a prize of 250 francs for the best essay on the elementary principles of electricity. The competition is open to anyone who is employed in the electrical industries, but is intended primarily for operators or mechanics, and not for those who have received a technical education. Algebraic formulæ are not to be employed, but may be given in a separate appendix In general the demonstration of the fundamental laws need not be given, and the science of magnetism is not to be entered upon any further than is necessary for the explanation of electro-magnetism The essays must be written in French, and will be received up to January 1st, 1889.

Prof. A. E. Dolbear writes to an English journal, "I have had made nearly a hundred tests of the tensile strength of electrically welded bars of iron steel, and other metals. The results were of such a character that I can state positively that with Thomson's welding process it is possible to weld both wrought iron and steel so that the weld is as strong as the same cross-section in another part of the bar. I had a number of bars welded by an expert blacksmith and a number of similar ones by the electrical process for comparison, with the result that the electrically-welded bars were much stronger than those welded by he ordinary process. The bars were of various sizes, up to an inch and a half for iron, and three-fourths of an inch for octagon steel."

Business Mention.

H. G. Smiley has resigned his position as secretary and manager of the Electrical Protective Supply company and J. M. Lyon has been elected secretary in his place.

The Western Electric company of Chicago have just secured an order for five miles of cable from the Chicago Arc Light & Power company, and another order for 1,200 feet of 100-wire cable from the Chicago Telephone company.

The New York Insulated Wire company of New York are meeting with great success in the sale of their wires. It is a source of great satisfaction to them that their wires under the varied conditions of use, in salt water, in sewers, in places where they have been subjected to the attack of chemicals, proved their merit and that their insulation has withstood the most severe tests.

The Western Electric company is selling large numbers of Field & Firman 11 call boxes. Large orders have recently been received from Omaha, Milwaukee, Kansas City and Toledo. All these boxes are made under the Field & Firman patents which cover broadly all the features embodied in them. The company too is selling an unusual number of LeClanche batteries.

A few of the numberless uses to which small motors can be applied are shown in a recently published catalogue of the C. and C. Electric Motor company, 88-92 South Fifth avenue, New York. The company, by the way, is crowded to its capacity. Motors for either arc or incandescent circuits are manufactured and also portable batteries for running motors of the smaller sizes.

The Silvey Electric works at Lima, O., are putting in a new 100 horse power engine. They have been running with rented power heretofore, but have now received a 100 horse power engine, and expect their boiler next week. They have already manufactured fifty electric locomotive headlights, fifty arc lamps, 2,000 candle power, one number 10 dynamo, and are building a number 9 dynamo, and a 15 horse power motor for the street car company.

W. B. Pearson, manager of the Chicago office of A. L. Ide & Son after May 1st will be found in room 436 the Rookery, corner of Adams and LaSalle streets. The increasing business of these manufacturers of electric light engines has demanded larger and more commodious quarters than their former location in the Grand Pacific block possessed. Mr. Pearson in his choice of an office has shown wisdom in locating in one of the handsomest office buildings in Chicago and further in getting into close proximity to electric light companies who are gradually building up an "electrical row" in that part of the city.

The Railway Telegraph Supply company, M. A. Knapp, manager, has taken possession of their new quarters at 54–56 Franklin street. Four floors and a basement are occupied, the basement as a shipping and battery room, the ground floor as an office, the second and third by machinery and the fourth floor as an assembling room This company is one of the electrical manufacturing companies of the west that is climbing rapidly to the top. Since its organization the advance has been steady and rapid and the prospects are that the present quarters larger and more commodious than those just vacated will be found too small and confined at the 1st of next May.

The Waterhouse Electric & Manufacturing company of Hartford, Conn., write to their Chicago office 154 LaSalle street, C. F. Dunderdale, manager, that they have just installed plants at the Atlantic Cotton mills, Lawrence, Mass., 45 arcs; Wilkesbarre Lace company, Wilkesbarre, Pa., 35 arcs; New Home Sewing Machine company, Orange, Mass., 70 arcs; and that they have just received notice of a contract awarded for lighting a portion of the Ohio Centennial exposition, furnishing 180 arc lights for the purpose. All of the plants of the Waterhouse system were running through the storms of the past winter, no reports of lights extinguished having been received and excellent satisfaction being given everywhere.

The Electrical Construction company is now located in pleasant and commodious quarters at 175 Randolph St. One of the features of the salesroom is a large show board used for exhibiting the different electrical appliances manufactured and sold by the company. Appliances for lighting gas by electricity, annunciators, burglar alarms and other kinds of apparatus are in position and are so arranged that their advantages may be readily shown to the customer. The show board too is a handsome and ornamental addition to the salesroom. The company has a well equipped shop in the rear in which excellent work is executed. The corporation is a young one, less than a year of age, but those interested in it are enterprising and have recently secured several large orders for electrical apparatus.

The Rose Polytechnic institute is one of three or four schools in the United States which are especially devoted to the education of civil and mechanical engineers It owes its existence to the generosity of the late Chauncey Rose, of Terre Haute, Ind., who bequeathed something more than half a million dollars for its establishment and support. It is one of the youngest of the technological schools of the country, having been opened for instruction in the year 1883. One of the peculiar features of the institute is the thorough and extensive "shop practice" of the students in mechanical engineering. Not only are machines designed and working drawings made, but actual construction is required and is made possible in extensive workshops, the equipment of which has cost over forty thousand dollars. Especial attention is given to the study of electricity and its applications, for which excellent facilities are provided in the equipment of the extensive laboratories. The plan of the institute is to restrict the attendance to such an extent as to realize the benefits arising from small classes. Ample facilities will therefore be afforded to all who undertake the courses of study. Those who are contemplating preparation for either mechanical or civil engineering, will do well to consult the catalogue of the Rose Polytechnic institute.

The Westinghouse Machine company have recently been making some tests of their new automatic compound single acting steam engines, both condensing and non condensing. The results, tabulated on blue prints, with which this office has been favored, are remarkable. The company write as follows concerning the tests: "The results thus far obtained are almost as surprising to ourselves as to others who are conversant with the facts. The tests are still in progress, principally to obtain statistics at a higher range of steam pressures than has heretofore been available in our own works. In our ordinary automatic engines—of which some 3,000 are now in use—the principal points that seem to have won public favor may be briefly stated as follows: 1st, the complete avoidance of the effects of lost motion on all reciprocating parts by the self-compensation of the single acting principle; 2d, a high enough initial speed to admit of the engine transmitting its entire power, through direct connection, to the work to be done, rather than to waste a large percentage of it—and the fuel consumed—in propelling devices whose sole object is the production of requisite speed; 3d, a complete automatic lubrication of every part, so as to provide against the frailties and weaknesses of human nature; 4th, an automatic governor, so lubricated constantly that the standard rate of speed is maintained on each and every stroke of the engine, instead of maintaining an average rate of speed; 5th, through our high speeds—forbidden in double acting engines—less weight per horse power; less loss through internal condensation; less space occupied, and less cost to the buyer. Some other points of superiority in our automatic engines have been commended, from time to time, but need not be referred to specially. In designing the new engines, our aim has been to cover all the features now so popular in our automatic engines, and to add the following points, which we consider desirable: 1st, to obtain the recognized economies in fuel, to be had through compounding, without any complication or excessive cost, so that these engines can be placed on the market, in the strictly commercial sense, from the smallest size to the largest; 2d, practically no more complication or mechanism than exists in the simplest engine; 3d, a greater economy of fuel than heretofore obtained by anyone in engines of equal horse power; 4th, a complete and perfect control of the steam supply to both high and low pressure cylinders, through the medium of a single balanced value; 5th, the ability to maintain an absolutely constant speed under varying steam pressures and loads; 6th, the best results throughout combined with the greatest simplicity and the least cost. The blue prints sent you have been made from

time to time, as the tests progressed, and do not represent the finished engine in the condition in which it will be placed upon the market. They are only intended to convey to your mind the general principles of design and to give you some idea of the results obtained."

Electrical Patents.

Issued April 24, 1888.

381,531. Telephone Receiver. William H. Collins, Chicago, Ill.

We give the last claim: "4. In a telephone receiver, the combination, with the vibratory diaphragm of magnetic material, of the central soft iron core, a coil of primary wire surrounding the same and connected to a battery or other source of electricity, a coil of secondary wire surrounding said primary coil and connected to the line, the cylindrical auxiliary soft iron core surrounding the said core and coils and itself surrounded by a coil of the primary wire, and an iron plate on which both cores are mounted."

381,542. Solution for Voltaic Batteries. Charles E. Egan, Columbus, Ohio.

The claims are as follows: "Claim 1. An excitant for a galvanic battery containing ferric sulphate and a chromic compound.

"2. An excitant for a galvanic battery consisting of ferric sulphate, chromic acid, and water."

381,555. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The invention consists in a system of electrical conductors where the total resistance offered to the current in completing its circuit through the motor, be it close to, or a long distance from, the supply station, is constant or substantially so. "Claim 1.—In an electric railway, the combination of two working conductors, an electrically propelled vehicle receiving electricity therefrom, and a generator of electricity having its poles connected with said working conductors at relatively different distances from one terminal of the line, whereby the resistances from the generator through the line motor and return are equal or substantially equal for all positions of the motor on the line between the connections of the generator with the conductors."

381,556 Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

381,568. Steam Dynamo Electric Machine Richard H. Mather, Windsor, Conn.

The first four claims read as follows: "Claim 1—A dynamo electric machine having a ring armature, in combination with a rotating or revolving steam engine, which is surrounded by said armature.

"2. A dynamo electric machine whose armature contains a steam engine.

"3. A rotating or revolving steam engine having a general cylindrical form, in combination with a dynamo electric armature, which is rigidly attached to the periphery of said engine.

"4. A steam engine and a dynamo electric machine, combined in such a manner that the armature shaft of the dynamo is utilized as a steam and exhaust pipe for the engine."

381,576. Electric Signaling Apparatus. Myron W. Parrish, Detroit, Mich.

381,585. Trap for Electric Railway Conduits. William M. Schlesinger, Philadelphia, Pa.

381 614. Electric Light Carbon. Thomas L. Clingman, Asheville, N. C.

The invention consists in mixing with any variety of carbons of pencils powdered serpentine, adapted to prevent their too rapid consumption.

"Claim An electric arc light carbon having powdered serpen ine commingled with its composition."

381,636. Armature for Dynamos. Moritz A. Muller, Newark, N. J.

"Claim 1. The combination, with the cylindrical armature core of a magneto or dynamo electric machine, of rows or series of insulated pins or plugs inserted in the ends of the core, substantially as described, and insulated conductors wound longitudinally upon the core and around the said pins or plugs, as set forth."

381,650. Electric Motors for Railways. Sidney H. Short, Denver, Col.

381,653. Conduit. James Steel, Paterson, N. J.

381,669. Combined Station Indicator and Signaling Apparatus for Railway Trains. John H. Bickford, Salem, Mass.

381,693. Electric Alarm for Ships' Compasses. Augustus Gross, Newcastle, New South Wales.

381,700. Armature for Dynamos. John F. Kelly, New York, N. Y.

By the use of this invention the pole pieces and projection at the ends of the core are practically dispensed with and, in lieu thereof, rows or series of insulated cleats or stops are employed at the ends of the core and, instead of carrying the entire coil around one stop a limited number of convolutions, say one or two, are wound around each stop, so that the coils are spread out over the end of the core. The coils are thus made to occupy less space in the line of the axis and are better insulated and more perfectly wound. The claims read:

"Claim 1. The combination, with the cylindrical armature-core of a magneto or dynamo electric machine, of rows or series of cleats, stops, or guides located at the ends of the core, substantially as described, and insulated conductors wound longitudinally upon the core and around or through the stops or guides, as set forth.

"2. The combination, with the cylindrical armature core of a magneto or dynamo electric machine, of the serrated or notched slats or strips, of insulating material secured to the ends of the core, and conductors wound longitudinally upon the sides of the core and carried through the notches in the slats from one coil-space to another, as herein set forth."

381,709. Annunciator and Signaling Apparatus. Morris Martin, Malden, Mass.

381,725. Electric Door Opener. John Schneider, New York, N. Y.

381,736. Electric Indicator. Edward Weston, Newark, N. J.

The invention relates to voltmeters and ammeters and consists in a particular way of suspending the movable magnet, the oscillations of which are used to indicate variations of current.

"Claim 1. In an electric indicator, the combination of a solenoid or hollow coil with a core having its longitudinal axis coincident with the axis of the solenoid, and springs for supporting said core, which are flexible in one direction, so as to permit the free longitudinal movement of the core, and rigid in other directions, to prevent any lateral movement of the same."

381,738. Telegraphic Signaling Apparatus. James B. Willis, Portsmouth, County of Hants, England.

381,764. Telegraphy. Patrick B. Delany, New York, N. Y.

381,765. Electric Bell. Constant F. De Redon, New York, N. Y.

381,768. Regulation of Electric Motors. Stephen D. Field, Yonkers, N. Y.

The field magnet is constructed with separate coils, more or less of which may be included in circuit at will, and the armature is provided with adjustable commutator brushes the positions of which are dependent upon and determined by the amount of field magnet coils in circuit. A single lever serves to change the circuit connections of the field magnet coils and the position of the brushes. A second lever serves to reverse the connections of the circuit through the armature, and at the same time to so change the relations of the brushes and the controlling lever that the cutting out of the field magnet coils will be accomplished by a movement of the commutator brushes in the proper direction Claim 1 is given:

"Claim 1. The combination, with an electric motor having field magnet coils of variable active length, of a circuit controller determining the amount of said coils in action, a current reverser for the armature, a commutator adjustment, a mechanical connection between the latter and the circuit controller, and means for reversing the said mechanical connection by the operation of the current reverser."

381,772. Electrical Annunciator. John Geary, Philadelphia Pa.

381,780. Electrical Measurement Apparatus. Hammond V. Hayes, Cambridge, Mass

The object of the invention is to provide an apparatus whereby the relative efficiency of transmitters or induction coils may be readily and quickly determined and whereby different electrical currents may be accurately compared, or whereby the efficiency of any current developed from the same transmitting instrument may be noted at different points of a long circuit and its fall in power determined as the distance from the transmitting end increases. Claim 1 is given:

"1. An instrument for the comparative measurement of electrical currents, comprising, in combination, a single coil or helix in a circuit conducting a current to be measured or compared, an additional coil or coils in a circuit including a receiving telephone, a support for said coils, and means whereby one coil can be moved toward and away from the other until a point is determined where the current in the first coil ceases to act inductively on the second coil or coils."

381 789. Dynamo Electric Machine and Motor. Moritz Immisch, London, County of Middlesex, England.

We give claim 2: "The combination of an armature for dynamo electric generators, the coils of which are connected to form two continuously closed circuits, a double commutator, the segments of which are arranged in alternation, connections extending from alternating armature coils to one portion of the commutator, and similar connections extending from the remaining coils to the segments of the other portion of the commutator, and separate commutator brushes for each portion of the commutator, said brushes bearing upon the alternate commutator terminals of the respective armature circuits and adapted to be connected in series or parallel."

381,794. Transformation and Distribution of Electric Energy. Rankin Kennedy, Glasgow, County of Lanark, Scotland.

The invention has for its object the saving of prime cost in laying down the main supply conductors, and comprises the supplying of high potential alternating currents of electric energy for operating secondary generators in great numbers from a central supply station.

Claims one and three: "Claim 1. The combination of an electric generator or generators with three main conductors, secondary generators in parallel or multiple arc connection to said main conductors, and translating devices in the secondary circuits of the secondary generators.

"3. An electrical distribution system having three main conductors, means for supplying high potential alternating currents of electric energy to said conductors, secondary generators in parallel or multiple arc connection to such main conductors, and translating devices in the secondary circuits of said secondary generators."

381,815. Heating by Electricity. Elias E. Ries, Baltimore, Md.

First and last claims: "Claim 1. In a system of heating by electricity, the combination, with suitable low resistance supply conductors, of one or more exposed heat developing conductors arranged in multiple arc between the supply conductors.

"12. In a system of heating by electricity, the combination of a source of alternating or interrupted current, an inductional transformer in circuit with said source of current, a heating circuit of low resistance supplied with current from the secondary coil or coils of said transformer, exposed heat radiating conducting bodies connected in parallel order between the conductors of the heating or secondary circuit, and a thermostatic cut out for opening the circuit whenever the heat developed therein exceeds a predetermined temperature."

381,816. Electric Heating Apparatus for Railway Cars. Elias E. Ries, Baltimore, Md.

We give the tenth claim: "10. In a system of heating cars by electricity, the combination, with a car and one of the axles thereof, of a counter shaft in continuous mechanical connection with said axle, an alternating current generator and a separate continuous current exciter therefor, the armature of both machines being mounted upon said counter shaft, inductional transformers arranged to receive the current from the generator and to transform the same into one of lower potential but increased intensity, heating devices upon the car arranged to develop heat from said current, and a pendulum or gravity switch arranged to operate when the car is traversing a grade and to cut out more or fewer of the coils of the field magnet of the exciting generator as the grade is of greater or less steepness."

381,817. Electric Heating System. Elias E. Ries, Baltimore, Md.

Claim seven is appended: "7. The combination, with a source of continuous currents, of a secondary battery in circuit with said source and arranged to be charged thereby in series, a commutator switch having terminals connected with each separate cell or group of cells in the battery, a distributing switch to which the battery switch is connected, and whereby any desired portion of the cells of the battery may be connected in multiple arc, and a heating circuit of very low resistance, an inductional transformer, the secondary coils of which are connected with the heating circuit, the primary coils whereof extend to a pole changer, and connections between the separate portions of the interrupter and the distributing switch for supplying the current thereto, substantially as described."

381,818. Method of Electro-Chemical Heating. Elias E. Ries, Baltimore, Md.

The invention consists in generating steam from the requisite quantity of water by the caustic action of soda, potash, lye, or their equivalents, distributing the steam so generated to different points of consumption, employing exhaust steam to extend and re-inforce the activity of said caustic substance by subjecting it to the heating agency of an electric current. We give the first and last claims:

"Claim 1. The herein described method of revivifying a steam generating substance located in a receptacle having heat giving qualities, which consists in periodically subjecting the same to the heating effect of an electric current or currents.

"6. The herein described method of revivifying a heat generating substance located in a receptacle and having heat giving qualities, which consists in converting high tension electric currents into currents of lower tension and heavier heating effect and periodically subjecting said substance to the heating effect of such converted currents."

381,819. Heating Railway Cars by Electro-Chemical Means. Elias E. Ries, Baltimore, Md.

We give the last claim: "16 The combination, with a steam boiler having a compartment containing a chemical heat generating substance, of an electric conductor in contact with said substance, and in circuit with an inductional transformer, automatic circuit controller for changing an electric circuit according to the temperature of the chemical substance, an inductional transformer having a primary of fine wire, a secondary of coarser wire, and in circuit with an alternating dynamo, a current regulating solenoid switch for maintaining a uniform generation of current by cutting in or out the field coils, a secondary battery in circuit with the said solenoid switch and with the primary of the inductional transformer, and an alternating dynamo operated by the momentum of the train, as specified."

381,823. Electrical Bell or Mechanical Striker. John H. Bickford, Salem, Mass.

381,839. Dynamo Telegraphy. Francis W. Jones, New York, N. Y.

Apparatus is shown whereby dynamo machines or secondary batteries of low internal resistance may be employed for working duplex and quadruplex telegraphs.

381,852. Electric Fire and Burglar Alarm. Andrew Schuchman, Springfield, Ill.

381,856. Electrical Apparatus. Clarence C. Sibley, New York, N. Y.

381,862. Suspended Cable and Electric Railroad. George R. Taylor, Louisville, Ky., and William Heckert, Yonkers, N. Y.

381,866. Electrical Method of Automatically Controlling the Supply of Water or Gas. Leopold Weil, New York, N. Y.

381,896. Automatic Fire Alarm System. John Young, Chicago, Ill.

The claim is as follows: "Claim. In an automatic fire-alarm system, a sounder of high resistance permanently placed at the terminal of a circuit of a building back of the thermostats, and a key permanently connected with the circuit for closing said circuit through said sounder, whereby a test may be made to determine whether the circuit is complete without operating the signal apparatus included in said circuit."

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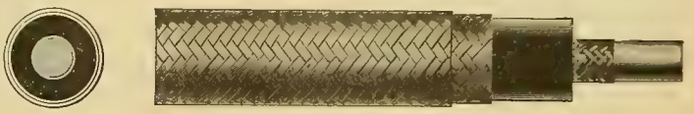

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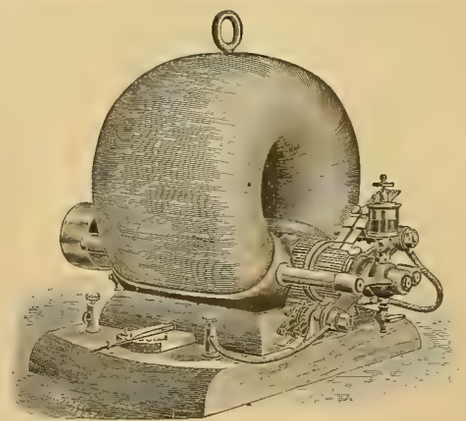

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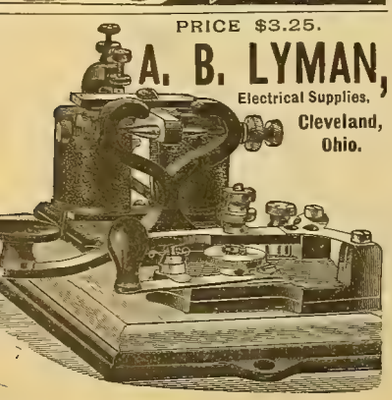

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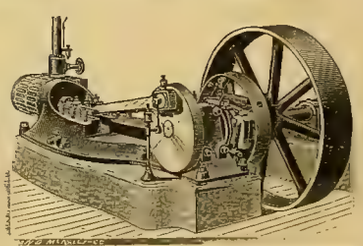

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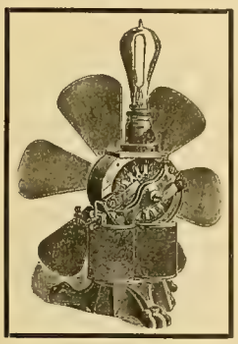

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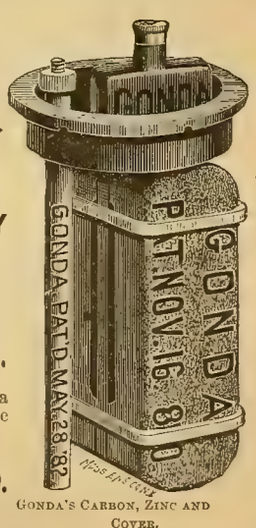

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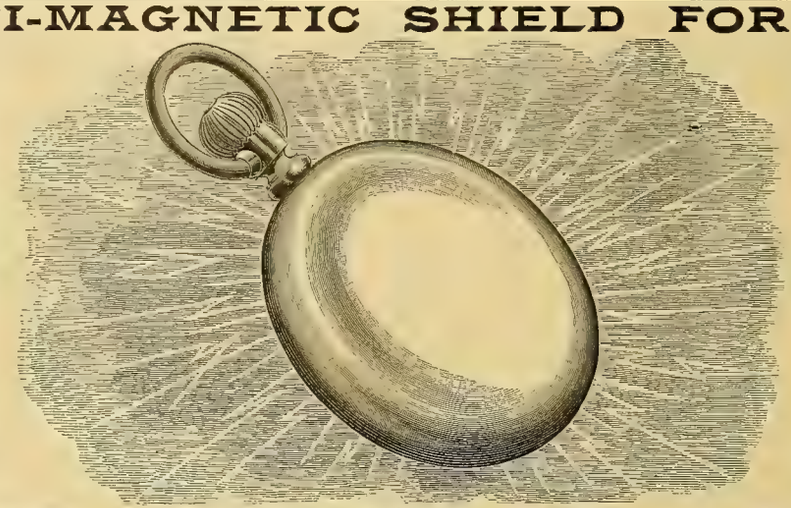

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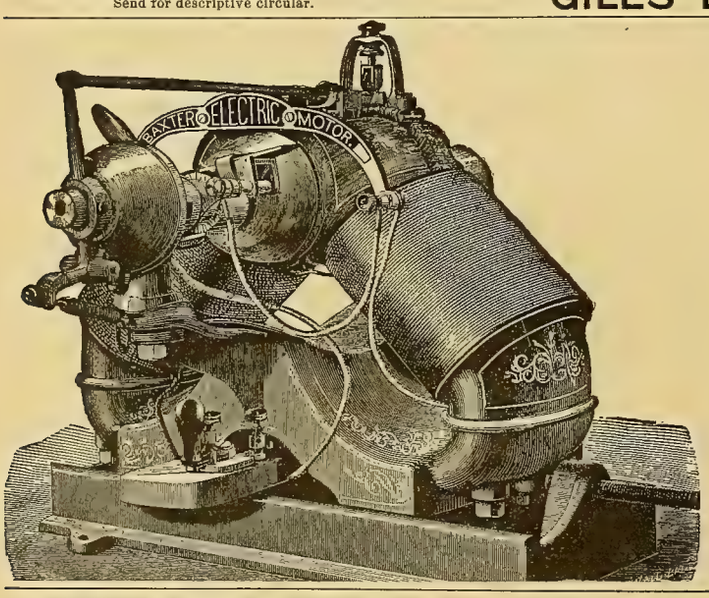

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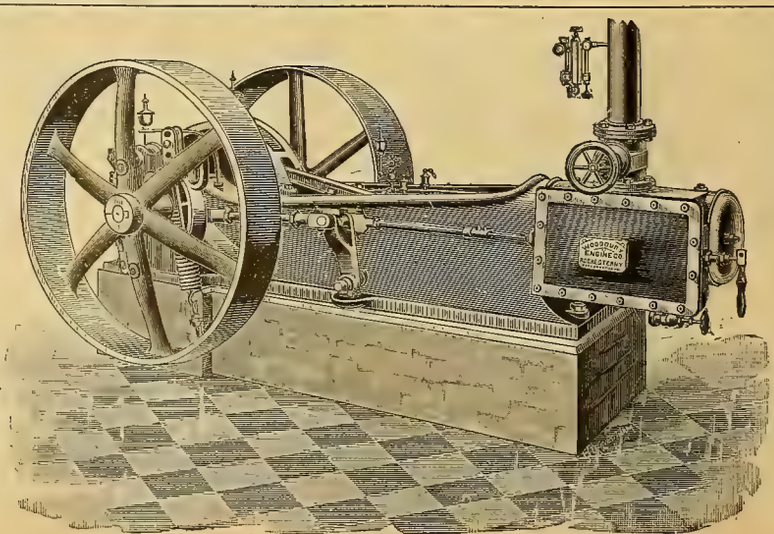

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FOR FITTING ELECTRIC LIGHT SOCKETS TO GAS FIXTURES.

No more burnt wire conductors where this attachment is used.

Remove gas burner, screw nozzle in its place; by replacing and screwing gas burner on nozzle, you effect a solid, permanent, gas tight job. Send orders to

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Faraday Carbon Company.

PITTSBURGH, PA.

Sad Ending.

KANSAS CITY.—A drummer from Chicago stabbed himself with a penknife, and bled to death before aid could be summoned. He was using the knife vigorously trying to prove that P. and B. insulation was worthless. The insulation was so tough it would not cut and the knife slipped. As there was much force used and the knife was very sharp, the result was fatal.

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The Electrical Supply Co. are sole agents for the Chicago Copper Refining Co.'s blue vitriol.

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C. H. Cone, the Electrical Supply Co.'s popular representative in Kansas City, says that he has gained twenty-five pounds since he commenced selling P. and B.

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New batteries are from time to time advertised, but the old reliable Diamond Carbon Battery still keeps to the front. There would be fewer divorce suits if this battery only was used in households. Bells always ring when the Diamond Carbon Battery is used.

What is a Chestnut?

A Chestnut is a man who says P. and B. insulation is too thin and cannot tell you why. Keep your eye on him.

P.

—AND—

B.

"As a Substitute for the Old Fashioned Underwriters', P. and B. is a Grand Success."
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BRANCH OFFICE,

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Milwaukee has an overhead circuit of P. and B.

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Please don't compare P. and B. to an insulation that can hardly hold on—even before the line is constructed. It won't hurt P. and B.—but you'll never go to heaven if you do.

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IMPROVED AND BETTER THAN EVER!

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MANUFACTURED AND CONTROLLED BY THE

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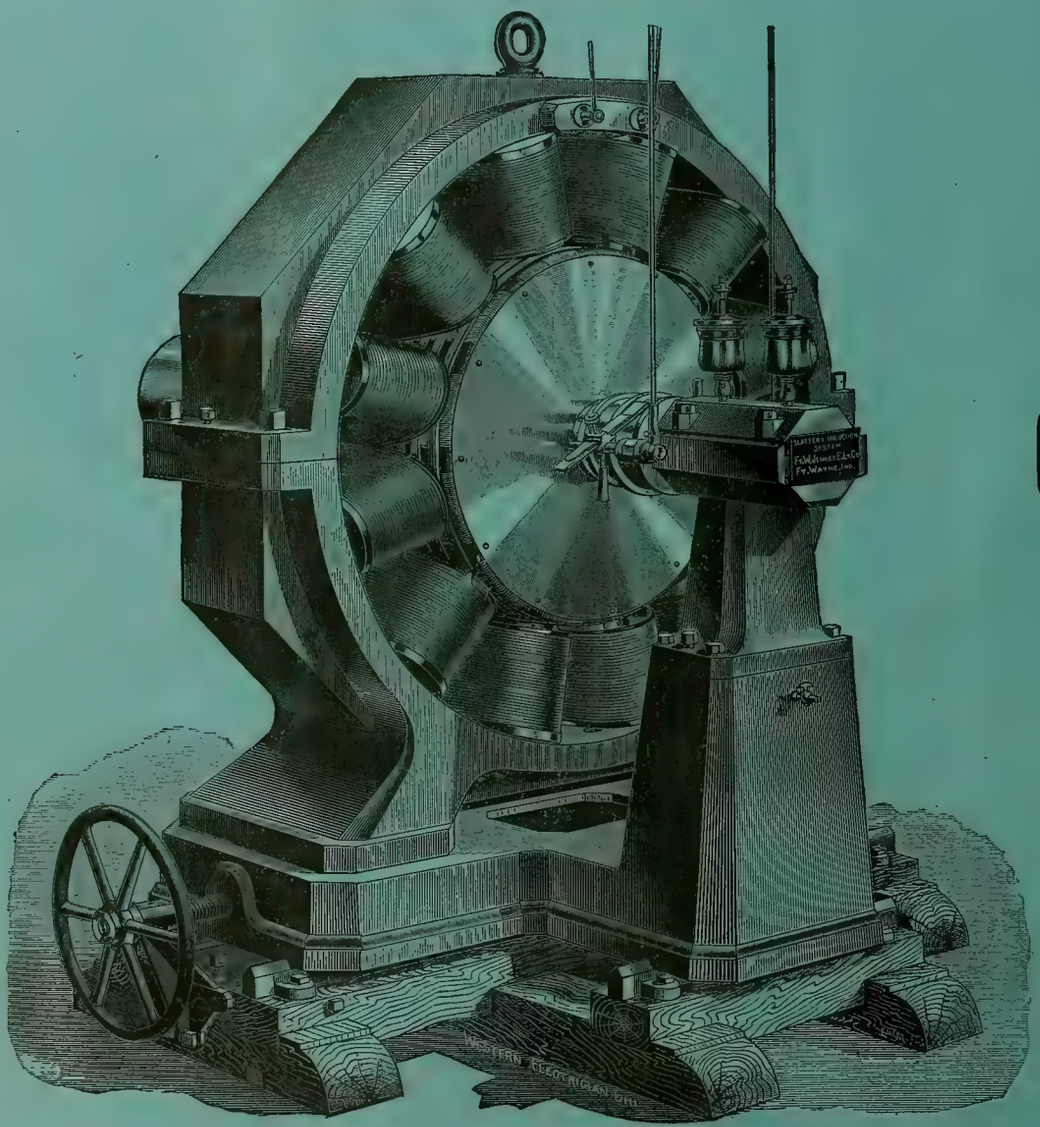

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16

Candle Power Lamps

TO THE

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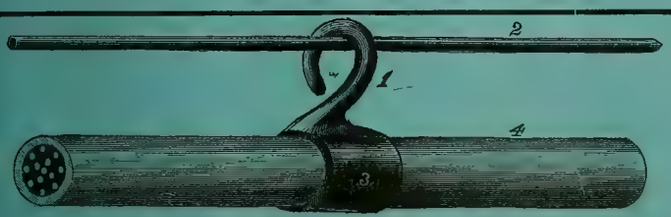

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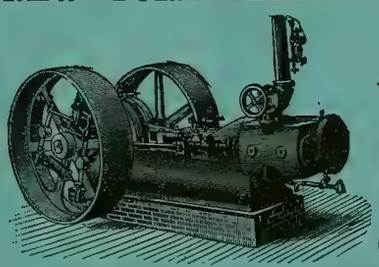

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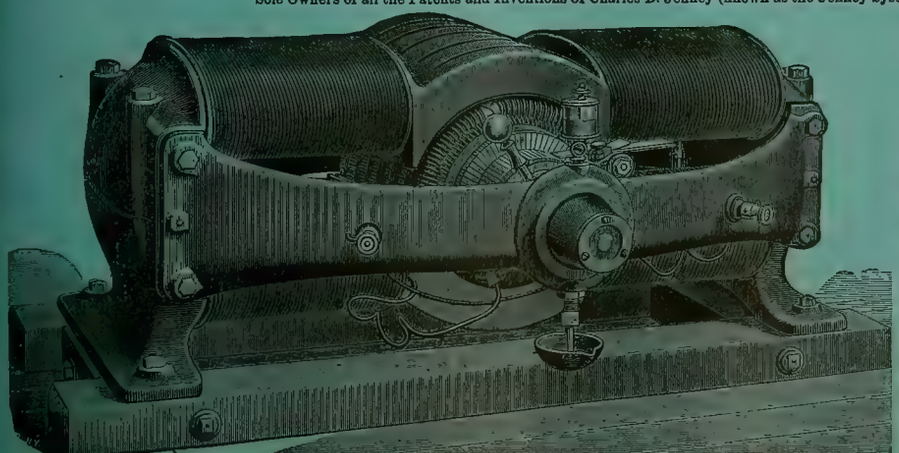

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In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

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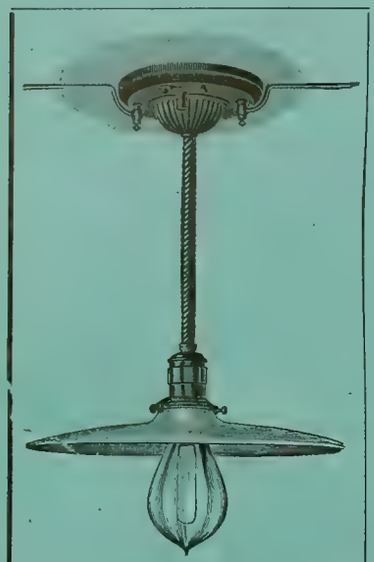

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These Lamps have repeatedly shown their superiority under test.

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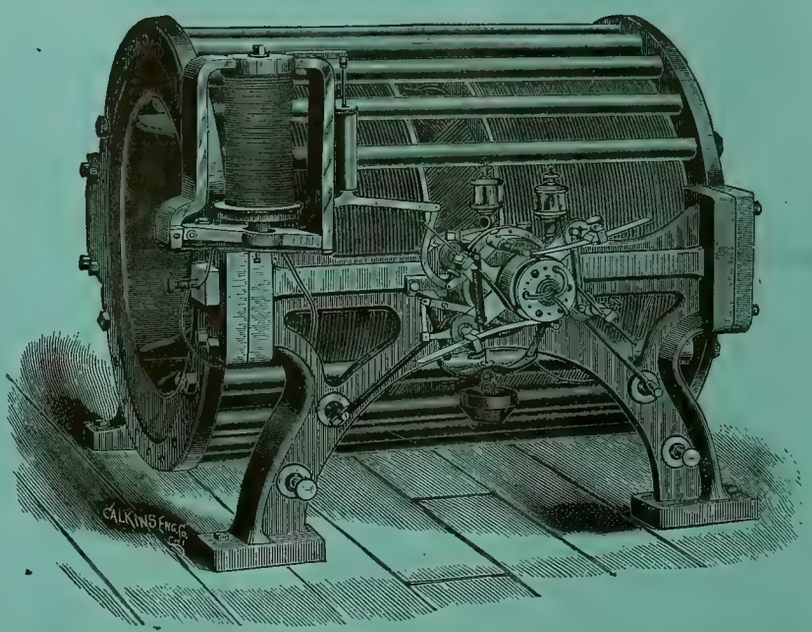

This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

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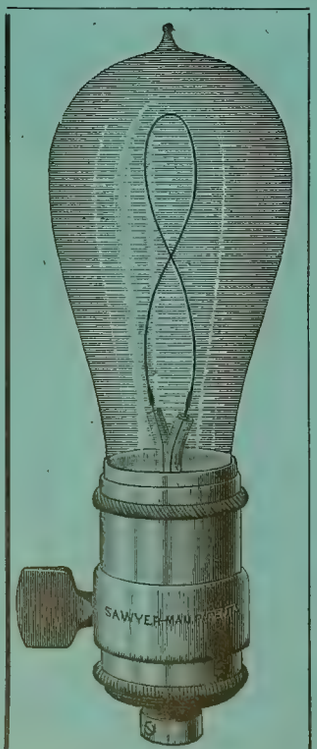
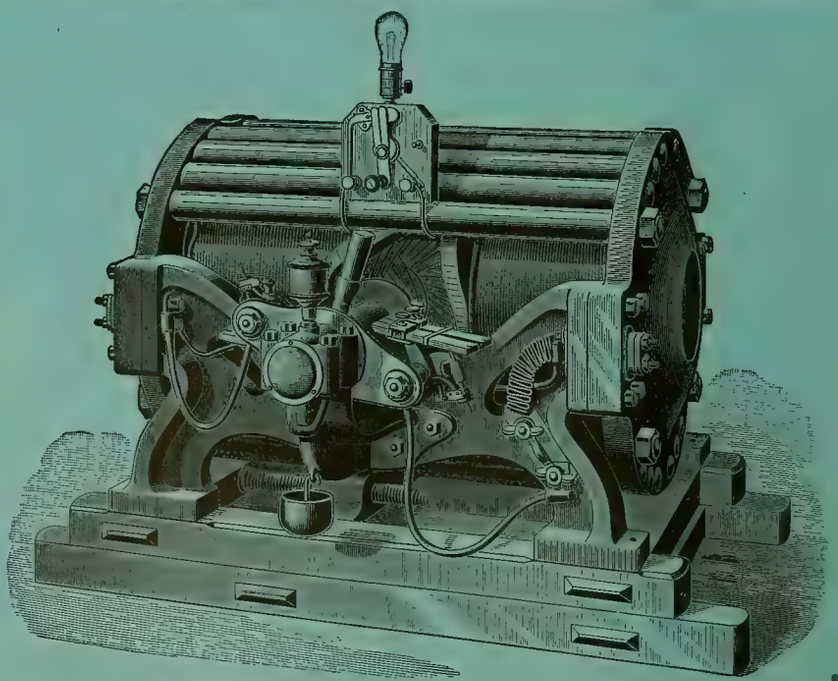
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

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OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

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Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.
G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

LEONARD & IZARD, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(SIGNED) G. H. THAYER, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

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610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

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which is **superior** to all other compounds for **BATTERY COPPERS, SWITCH-BOARDS** and **INSTRUMENT CONNECTIONS.** Our

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are absolutely **WATER** and **ACID PROOF**, and have no equals for movable **INCANDESCENT LIGHTS, SWITCHES** or **BATTERY CORDS.** Our

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for **ELECTRIC LIGHT AND AERIAL USE**—**a new feature with us**—is under the direct charge of an expert, who was twenty years superintendent for Siemens, of London, and has had more experience than any other man in America in insulating wires.

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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

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Which Patents absolutely control this The Only Permanently Established and Commercially Successful

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As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

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PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

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The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

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Compensation Balance and Hair-spring,

WHICH ARE

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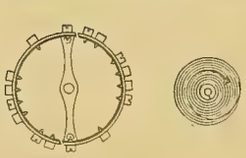

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They are especially adapted to the uses of

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and for durability, fine workmanship, and accuracy of performance are unsurpassed.

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MANUFACTURERS OF

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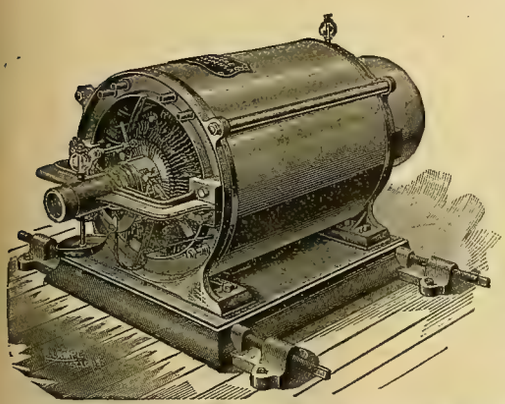
The only and original Alternating Current Long Distance Single Wire Incandescent.



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Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

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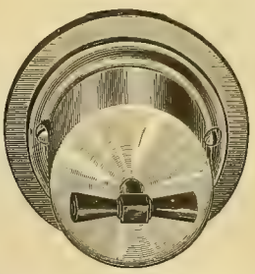
We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

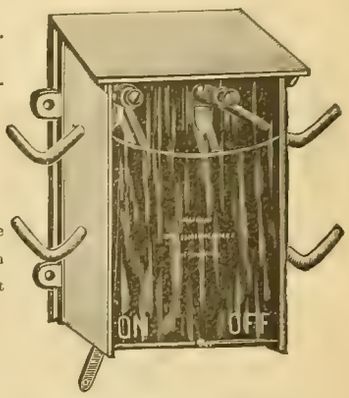
Forest City Electric Works,

Manufacturers of CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.





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Agents in all Cities. Send for Trial Belt.

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Communications are written with pen and ink in the handwriting of the person writing the message.

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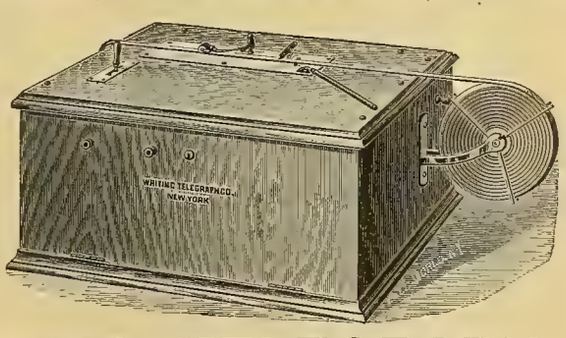

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All instruments are under the control of the Central Office, and messages are recorded on the instrument of a subscriber, whether he is present or absent.

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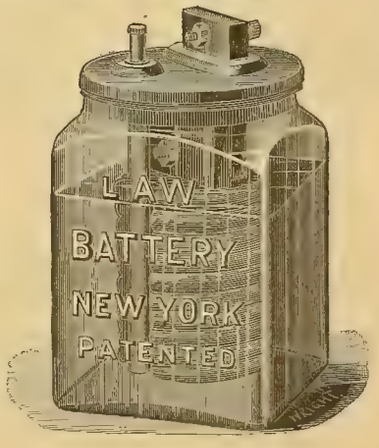

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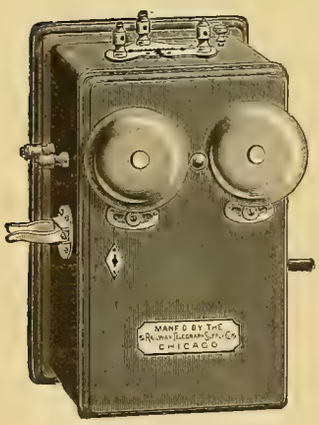

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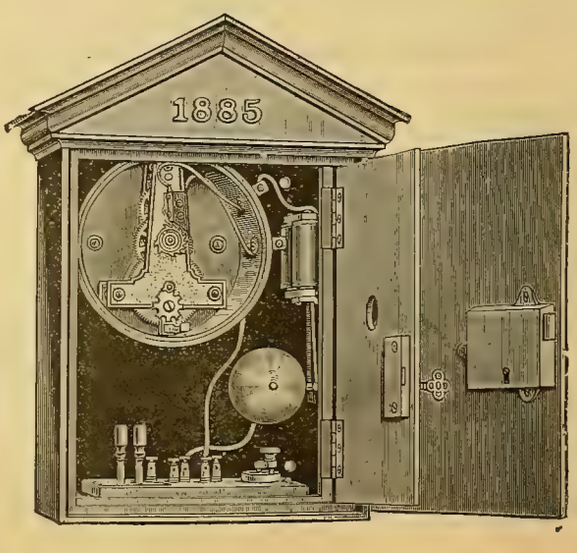

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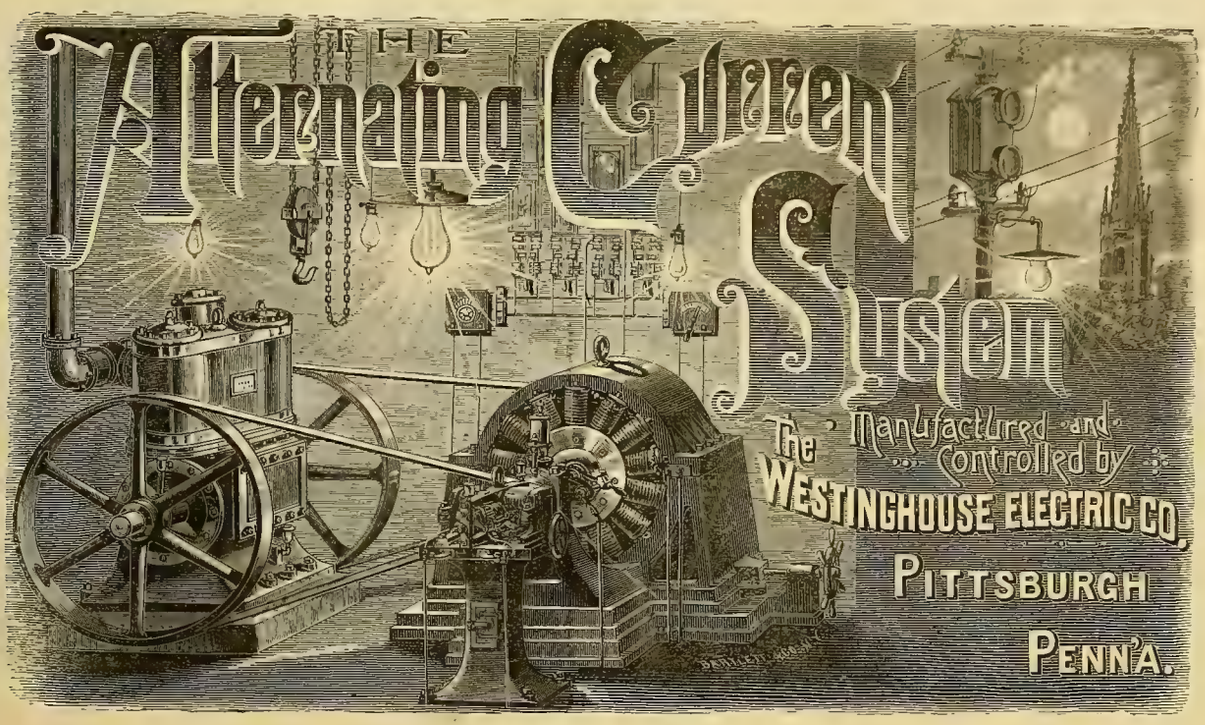

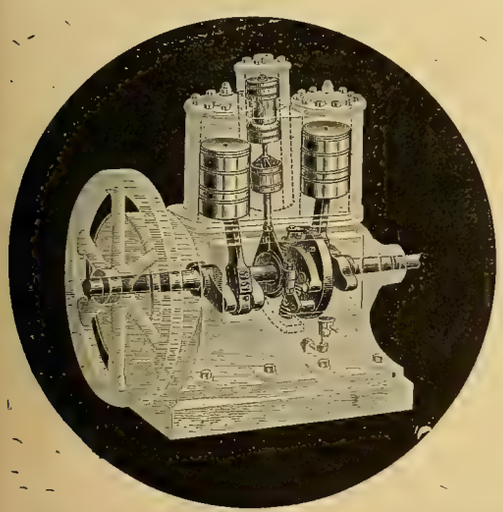

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We do not think any Battery except the LeCLANCHÉ, or any LeCLANCHÉ Battery except that of our manufacture, can show such a record as the following:

Western Electric Co., Chicago, Ill., April 10, 1888.
Chicago, Ill.

Gentlemen: Replying to your inquiry of this date, I would say, I have kept a record of the service we get from many of the Disque LeClanche porous cups furnished the Chicago Telephone Company by you since September, 1884. Without going into the minutiæ of this record I will state that it shows that we have had batteries in use which have been in CONSTANT SERVICE for about THREE YEARS and EIGHT MONTHS, and that the AVERAGE SERVICE which we get from porous cups of your manufacture is OVER ONE YEAR and SIX MONTHS.

Our inspectors are instructed to replace porous cups as soon as they show signs of failure, and many of the porous cups brought in as having been used up are still in fairly good condition and would give good service in places which do not require the work from a battery which telephone service requires.

Yours very truly,

J. J. NATE,

Purchasing Agent Chicago Telephone Co.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, MAY 12, 1888. No. 19.

The Hill Electric Lighting Apparatus.

Several valuable inventions in connection with electric lighting are illustrated herewith. They are improvements made by W. S. Hill, of Boston. Fig. 1 is an arc lamp of simple construction, having all the desirable features of modern practice, yet entirely free from delicate mechanism, which renders objectionable many arc lamps. They are made for currents varying from four to ten amperes.

A new cut-out switch for arc or series currents is shown in Fig. 2. The contact terminals are mounted at either end of a base board, between which is placed a stand carrying two spring levers with insulated connectors of thin sheet copper. A cam lever operates to depress and close either circuit before the other can be broken. If a loop or circuit of lamps in a building is to be cut into a main circuit, as the cam lever is turned the copper brush connectors will be pressed down between the inclined surfaces of the double pole terminals of the new circuit before the connection with the main can be broken. A stout spring that surrounds the axis to the spring levers is arranged to raise and open the circuit of both sets of connectors in common, as the handle is turned in either direction. The switch is covered with a neat box with a glass cover, through which the words "on" and "off" can be seen on the handle of the cam lever.

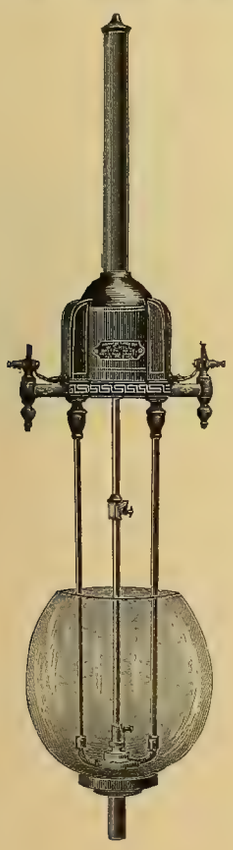


Fig. 1.

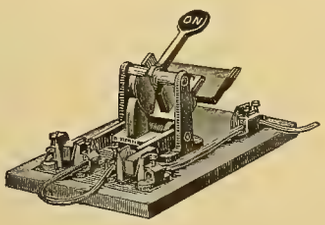


Fig. 2.

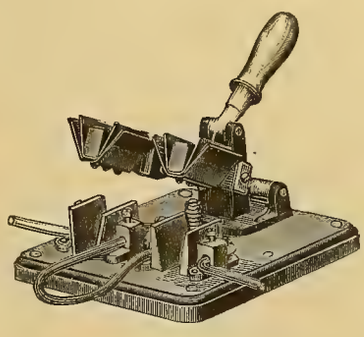


Fig. 3.

Fig 3 shows a double pole switch in which the same plan of contact connectors is used as in the cut-out switch. Two pairs of contact terminals are placed in line on the base board as shown, the inner side of which is beveled, so that when the wedge shaped contact brushes are pressed down between them, the most perfect electrical connection is obtained.

The connecting brushes are screwed to, and insulated from the pivoted lever, and as the handle is pressed down a projecting arm bears upon a cam surface on the lever and the connecting brushes are pressed between the inclined sides of the terminals, closing the circuit,—when the handle is raised, bringing the projecting arm off the cam surface, a spring pressure raises the lever and makes a quick break at both poles simultaneously. It is a solid and durable instrument, with large contact surface, and is well calculated to deal with large currents and to fill the requirements of electrical engineers and insurance inspectors.

Fig. 4 shows a dynamo of a new pattern, recently designed by Mr. Hill, that has several good features. The frame is made of cast iron, but the magnet cores and pole pieces are of soft wrought iron, the effect of which is to give nearly or quite as good results as if the whole frame was made of wrought iron, with a very considerable saving in cost. The armature is of peculiar construction, recently patented by Mr. Hill, and is claimed to develop no heat in the iron, the machine being guaranteed to run cool unless greatly overloaded, so as to cause heating of the wire from an excess of current. The field magnets are shunt wound for incandescent lighting and give perfect regulation. The dynamo has as yet been made only in small sizes of ten to one hundred lights. A machine weighing 280 lbs. gives 50 70 volt 16-candle power lamps at 2,000 revolutions. A 10-light machine weighs 125 lbs. A large machine for arc lighting is in process of construction and will be fitted with a new automatic current regulator, recently patented by Mr. Hill.

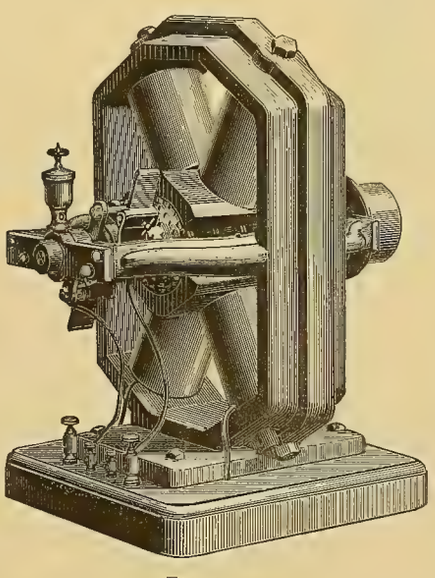


Fig. 4.

Fig. 5 shows a key socket and lamp, the new feature of which is the manner of attaching the lamp to the socket.

The lamp terminals are of stout wire, and are bent at right angles to form arms as shown in Fig. 6. As the lamp is inserted in the socket and turned partially round, these arms pass under wire springs, which hold the lamp securely in place, and also puts it in electrical connection with the circuit. A pin in the brass cup of the lamp, and a groove in the socket insure the lamp entering the right place, and limit the turning motion so no injury can come either to the arms or springs.

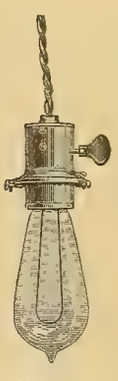


Fig. 5.

Fig. 6.

Chicago Electric Club.

The heavy rain storm of last Monday evening prevented many from attending the meeting of the Chicago Electric club. Considering the weather, however, the attendance was extremely complimentary to Mr. Cutter, who read the paper. Theo. P. Bailey was chosen secretary pro tem. in the absence of W. A. Kreidler. F. S. Terry, treasurer, presented a report in which he recommended that means be adopted for increasing the revenue of the club. He said the organization should endeavor to increase its membership. The members now number 120 and he thought the number should be at least 150. It was voted that the annual meeting should be held the third Thursday in June. An amendment to the by-laws was adopted fixing the initiation fee at $10 and the annual dues at $16.

The club then listened to Mr. Cutter's paper which is presented elsewhere in this issue.

Bernstein's New Current Meter.

Prof. R. Bernstein, of Berlin, has devised a current meter of novel construction. It consists of a dynamometer, whose indications are proportional to the current intensity; a planimeter which integrates the deflections of the dynamometer. The axis of rotation of the movable bobbin is placed at an angle to the vertical, and the proportionality of the deflection is obtained by a very ingenious device. A sector is affixed to the axis, and is balanced by a small weight attached to a cord which runs over a couple of pulleys. The form of the sector is so adjusted that the movement of the weight is always proportional to sin a tan a, a being the angle of deflection; and it can be shown that under this condition the tangent of the angle of deflection will be directly proportional to the current. The rotation of the axis of the coil displaces a disk over which a wheel moves in such a manner that its velocity is proportional to the angular displacement of the disk. The number of turns made by the wheel is registered by a train of clockwork. The apparatus is evidently available either for continuous or for alternating currents. —London *Electrician*.

A New Incandescent Lamp Socket.

Progressive electric light men recognize the fact that perfection in fixtures is as much to be striven after as perfection in the electric light itself. In fact without it perfection in operation can not be approached. A step in the right direction has been taken by the Electric Construc-

tion and Supply company of New York, whose new socket for incandescent lamps is illustrated herewith. It is claimed for this socket that by its use a perfect vacuum is obtained in the socket itself, and the consequent loss, where a socket which is not air tight is used, is avoided. It is said that the loss sometimes reaches ten per cent with socket not perfectly air tight.

To describe the socket, D is a brass shell, fitting into the lamp of course. This fitting is made perfect by stretching over it the rubber cap H. The heat of the lamp vulcanizes the rubber to both the glass and the socket, thus rendering the passage of air impossible; E is a brass screw cap which screws into D. This fitting is also made air tight by a rubber washer which the screwing in of the brass cap presses tightly into the joint. Another rubber washer prevents the passage of air around the stem G. It will be seen that all of the places where the air generally gets through are protected by these thin rubber caps and washers. Although hardly on the market it is said that these sockets have already received the indorsement of some of the large incandescent companies.

Why Have Cables?

On its face it is an absurdity to assert that those who are investing millions of dollars in a street railway plant have not fully informed themselves of the relative advantages and disadvantages of all existing methods and that the average public, with its nickel interest in the matter, is a competent critic in the premises. But the stubborn fact of the North side cable failure is even a greater absurdity. Nobody knows what it really cost except Mr. Yerkes, and he won't tell; but it is probably safe to say that every mile of the existing North side railway tracks could have been converted into electrical railways, or that all the cars could have been fitted with storage batteries or accumulators, for less than the cost of the partial cable equipment. And it is entirely safe to say that had either of these been done the North siders would now be rejoicing in reasonably rapid transit instead of cursing the malign influences which delivered them over to Yerkes. A half-million other people living on the West side are watching these developments with increasing interest. They are dreading the approach of the time threatened to begin the cabling of Madison street and are earnestly asking each other—a la Lord Arthur—Why have cables? The query is a pertinent one in view of the North side fiasco and the admitted success of various other forms of motors. It is to be hoped that the new noiseless steam motor, which is to have a trial to-day, may give a conclusive answer to the question.—*Chicago Daily News*.

Electric Light Installation At Hamburg.

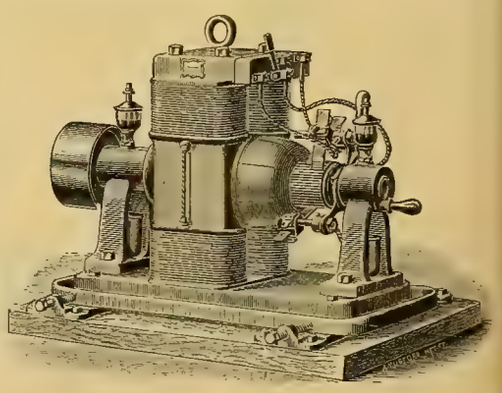
There is now in process of construction for the harbor of Hamburg, an extensive system of quays and bonded warehouses, covering an area of 430,000 sq. ft., lighted externally throughout by arc lamps, while the interior of the buildings is lighted by incandescent lamps; the installation including 50 ten-ampere arc lamps, and 4,000 16 candle power incandescent lamps. The arc lamps are grouped in five series of ten each, with a separate dynamo to each series, and one extra, while the incandescent lamps are placed in parallel, and supplied by six dynamos also. These are 8-pole Schückert disk machines, running at 350 revolutions, and giving a maximum current of 400 amperes, at 120 volts. The six arc light dynamos are operated by a single cylinder, non-condensing engine, with 14½ inch cylinder by 28½ inch stroke, running at 90 revolutions a minute. The six incandescent light dynamos are operated by three pairs of compound engines of 220 i. h. p. each; the high pressure cylinder 15¾ inches diam. by 31¼ inches stroke, and the low pressure 23⅝ inches diam. by same stroke; the speed being 100 revolutions per minute; automatic expansion and surface condensers being also provided. The dynamos are driven by belting from a main countershaft, receiving motion from the engines by rope gear. Each dynamo has on its countershaft pulley, a friction clutch by which it can be stopped or started without interference with the other dynamos.

There is an ammeter, voltmeter, and coulomb meter for each dynamo and circuit. The conducting cables are carried in rectangular iron troughs underground. The dynamos for the incandescent lights are all coupled in parallel by means of two bars on the distributing switch board, and pilot lamps, attached to small return wires connected with each main cable, serve as guides for the attendants. In the mains allowance has been made for a 14 volt loss. In coupling the dynamos the current is first regulated by a rheostat operated by hand, so as to obtain the same terminal pressure on all of them; the rheostats are then coupled together so that any further adjustment of terminal pressure required may be made simultaneously for all the machines. The pressure at the lamps is regulated by introducing resistance as required into each outgoing main; which is done automatically by a relay electro-magnet and rheostat to each main. The rheostat switch is in an insulated barrel with circular metal contact pins of unequal length, which, when the barrel is slowly revolved come automatically in action introducing a variable number of resistance coils into the main circuit. Each rheostat comprises 15 resistance coils of German silver; and the switch barrel is revolved in either direction automatically as required, by ratchet wheels which engage with pawls kept oscillating continuously by a shaft put in motion by the countershaft already mentioned. Each relay magnet is coupled to the return wires mentioned above, so that the attraction on its core is an exact measure of the pressure existing at the point of consumption. The core is suspended from an adjustable spring, and furnished at its lower extremity with a metal stud playing between two contacts so that a current may be sent through either one or the other of the two magnets controlling the two pawls. If the pressure is too great the core rises and a current passes through the magnet operating the pawl by which the switch barrel is so rotated as to reduce the number of resistance coils in circuit, but if the pressure is too small the core descends and a current passes through the magnet operating the pawl by which the movement of the switch barrel is reversed, and the number of resistance coils in parallel is increased.

The Waterhouse Self-Regulating Dynamo.

The Waterhouse Electric and Manufacturing company, of Hartford, Conn., have recently made some minor improvements in the details of their dynamos for small plants, and an illustration is given of the form of machine furnished with 3, 5, 10 and 12 arc light plants. The armature of this machine is larger than is usually furnished and is intended to run at slower speed. The commutator is made of Billings drop forged copper segments and is a very perfect piece of work. A new brush holder holds the brushes, and a groove at the outer edge of the base collects any overflow of oil from the oil cups. Slides are furnished with adjustable bolts for tightening belts.

The leading feature of the Waterhouse system lies in the self-regulation of its dynamos being electrical, and automatic. This self-regulation feature applies to the larger as well as the small dynamos. The commutator is provided with three brushes. There are three circuits; the field circuit passing from the armature by way of the upper main brush and around the field



magnet coils to a point where it is joined by the current from the local circuit. The local circuit starts from the armature at the auxiliary brush and passes outside of the dynamo to the point where it joins the field circuit and the sum of the two currents is the amount passing through the lamps. To illustrate the effect upon the dynamo when regulation occurs we will suppose that five amperes are passing around the field magnets, five amperes are passing around the local circuit and the sum of the two, ten amperes are passing to the lamps and returning to the armature by way of the lower main brush. At the instant lamps are cut out the current in the field circuit is reduced and the current in local circuit is increased but in a like proportion so that on the lamp line the standard is maintained. For instance, if lights are cut out and the current in the field circuit registers four amperes, the local would then show an increase to six amperes and ten amperes would be passing through the lamps the same as before. If the field circuit was reduced to two amperes the local would show eight amperes, so that no matter what number of lights are cut out the current passing around the field magnets is instantly reduced but the current on the lamp line remains normal. The value and importance of this remarkable effect on the generating capacity of the dynamo is apparent, because with the less current the strength of the field magnets is reduced and there is no power to build up above the standard and the safety of the apparatus is assured.

Line upon line. When your telephone line is crossed.

Sprague Electric Railway & Motor Company's Cars.

The question of rapid transit is daily becoming a problem of greater moment in cities and indications point to the fact that the electric motor is to be an important factor in it solution. The electric street railway has long since passed the experimental stage; it has been demonstrated that such a road is not only practicable but it is recognized as more safe, more economical, and more flexible than any of the rival modes of propulsion. The Sprague Electric Railway & Motor company has done important pioneer work in this direction. It has demonstrated in a score of instances the points of excellence which the electric road possesses. The railways which are operated on this system are attracting the careful attention of street car companies in all parts of the country and almost daily the announcement is made that horse power on some road has been abandoned for the electric current.

Cars which are daily running on two of the roads operated under the Sprague system are illustrated herewith. The Richmond road Fig. 1 has been one of the most successful in spite of obstacles which were met in the installation. On May 6th this road carried 11,000 passengers. Twenty cars are now running and ten additional cars have been ordered and will soon be in operation. The total trackage is 12 miles. The maximum grade is $10\frac{1}{16}$ per cent. There are 39 curves. It will be seen by reference to the cuts that the system employs overhead wires.

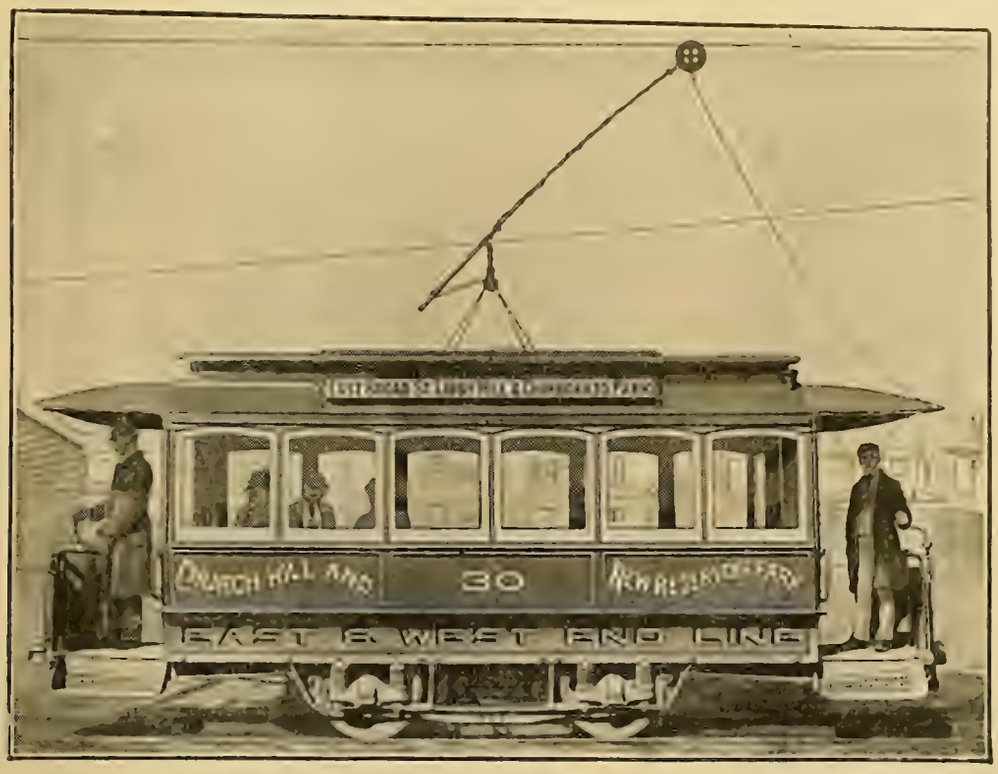


Fig. 1.

Another successful road is that at Carbondale, Pa., one of the cars of that road is shown in Fig. 2. The company in that city has found the system so satisfactory that an additional order for cars has recently been sent the Sprague company.

Fig. 2.

Pullman Electric Road.

Residents of Pullman will soon be supplied with means of rapid transit in that thriving town. Work is to be begun at once on an electric road, and next week a gang of men will make a start with the track laying. The road will run from 104th to 114th street, and the trackage will be about five miles in length.

The contract for the road has not yet been awarded but Mr. Pullman says the overhead system will be employed.

The road will possess several peculiar features, the exact nature of which has not yet been divulged. The cars will be elegant in design and finish and will be built, it is almost unnecessary to state, by the Pullman company.

The repeater may be good at office work, but should never be allowed at the polls.

The Continuous Current, Limited, vs. the Alternating Current, Unlimited.[1]

By George Cutter.

You will see by the title of my paper that I assume rather a more positive position than my predecessors in this discussion. I do not claim to be impartial, and then produce arguments wholly tending to one side of the question.

That the continuous current has done a great work in the distribution of lights from central stations, none of us will deny, and, that in certain cases it has been successful in spite of the limitations of such a method of distribution, we are also pleased to admit. The effort among the originators of central station systems has been in the direction of high potential. We are all more or less familiar with the many and various devices and methods that have been adopted to enable us to use high potentials in distributing our energy. This is not only the case in electrical work, but it is also the tendency in other classes of central station distribution. Outside of our own especial department, one of the most striking instances is the high pressure hot water system of distributing heat in Boston. The statement of the chief engineer of this enterprise seems to me quite appropriate to our work, in that he considers "The distribution of heat a transportation problem." We can also consider the question of distributing electricity a "transportation problem," and the question is, the cheapest method of transporting the energy we sell. The cost of installation for doing this should, of course, be as light as possible in proportion to the work accomplished.

In the discussion which followed the reading of the last paper before the club, I maintained a position somewhat different from the other participants in the discussion, and immediately decided upon the title of the paper that I rashly offered to prepare, viz: "Continuous Current, Limited, vs. The Alternating Current, Unlimited," because I wished to emphasize the arguments offered at that time. I do not wish to close the door on the continuous current, nor on any department of electrical work whatsoever, as I wish for the greatest work possible with electricity, and stand ready to rejoice at the success of any method, be it with continuous current or without. I think such a position should be made very prominent as it contrasts so forcibly with the spirit of the first paper. I wish merely to show that in the present stage of our industry, the alternating current has decidedly the best outlook.

Shortly after the reading of the first paper I prepared a picture of the pole line in front of a station of an Edison three-wire system in New England, with which I was quite familiar, and then also planned the necessary pole line for the same number of lights on the converter system. In the discussion which followed the reading of Mr. Slattery's paper, I mentioned this point, of the relative appearance of the wire work of the two systems, to show that the relative depreciation was not simply that between pure copper and transformers.

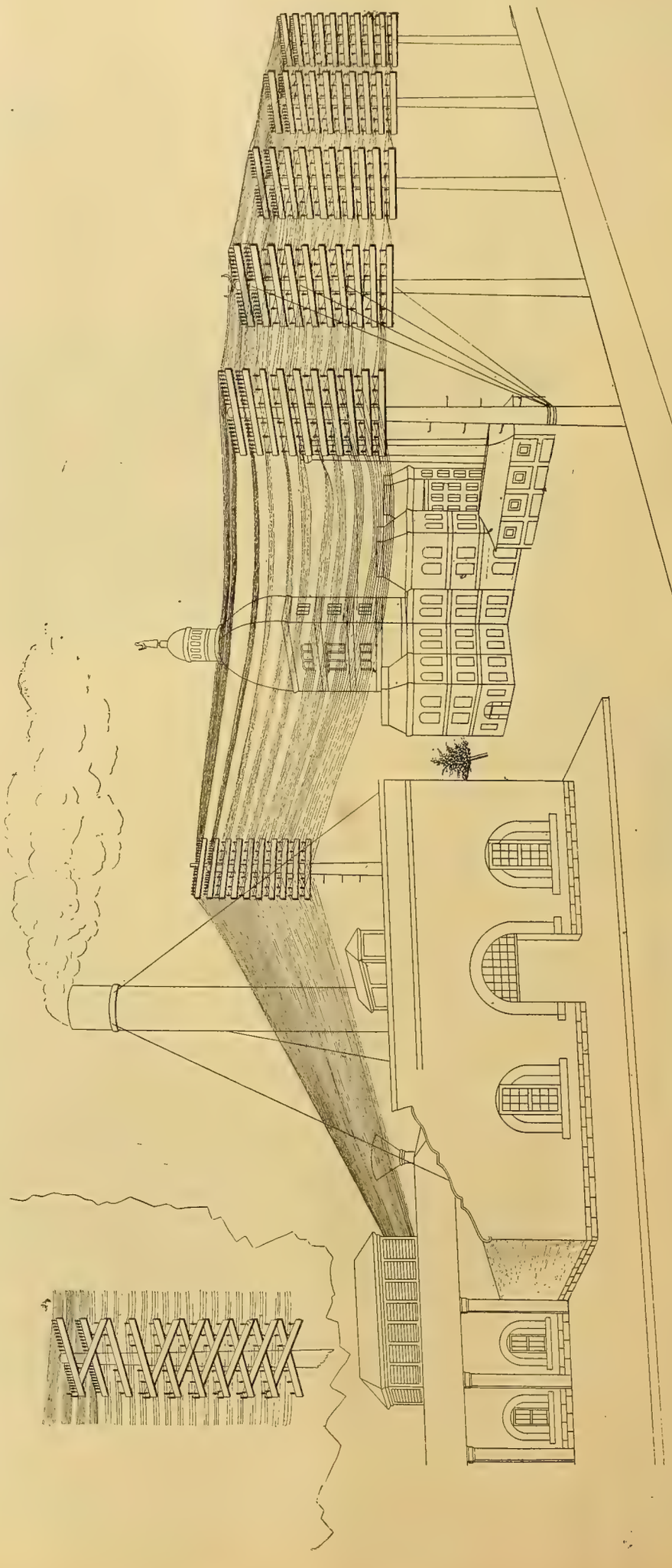
As Prof. Badt produced a very pretty picture of the three-wire system in Minnesota, I simply reproduce the same picture, with exception of the poles and wires. Here I have represented the necessary wires for 7,500, 10 C. P. lamps on the converter system. Not knowing the distance to the lamps that produced such a net work of wires as was pictured in Prof. Badt's illustration, I adopted the greatest distance which Mr. Leonard knew of an Edison feeder, viz: 6,000 feet. I then calculated on the basis of one-half the number of lamps at 3,000 feet, and one half, 6,000 feet away, which you will readily perceive would be an exceptionally difficult condition for the continuous current to fulfill. For this work I have 10 wires in place of the 54 as pictured for the three-wire system, and in place of a good many more than 54, as would be necessary if the lamps were distributed as I have figured, and the wiring was done on the three-wire system. Moreover, my figures are for 2½ per cent. drop, whereas the three-wire system is on a drop of 20 per cent. giving a good margin for any difference in efficiency in the apparatus. Mr. Bliss made the remark that "the plan selected by Prof. Badt was an exceptionally severe one for the three-wire system, inasmuch as all the wires went out in the same direction." I look upon it as a fair representation of the wiring for this number of lamps on the three-wire system, with the exception of having so many of them on the same poles. The difference would simply be, having more poles and more routes.

By leaving out some of the factors of the installation, it is easy to maintain by figures most any position we wish. This is the method adopted by some business men, and it is also the method in the first paper. No account whatsoever, was taken of the construction of the plant, or of the cost of poles, etc., which make up part of the installation, and which all tend to increase the cost of the three-wire system much more rapidly than that of the alternating converter system.

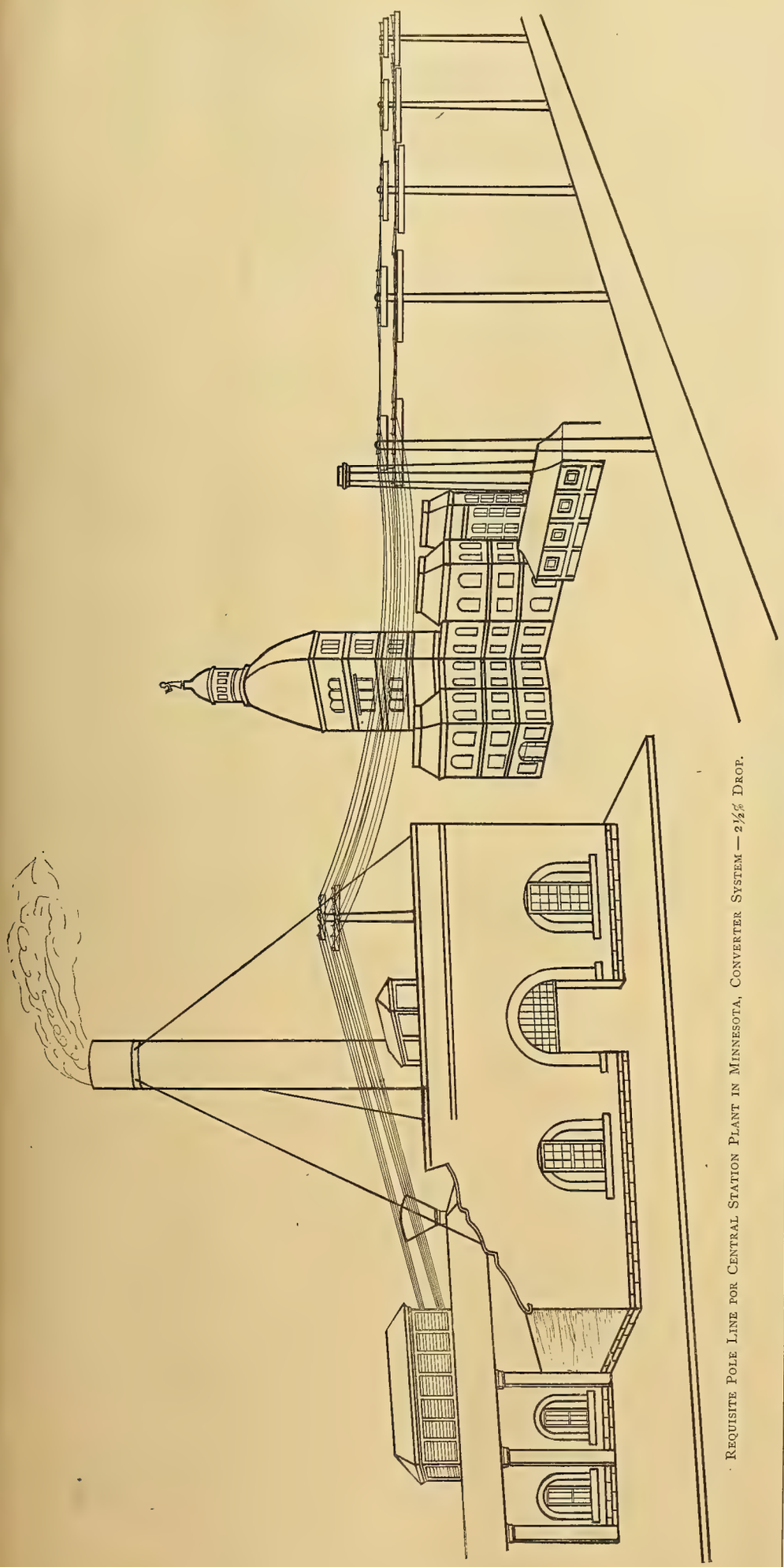
Mr. Leonard figures the cost of copper for the feeders of the three-wire system, and the copper and the converters in the converter system, and draws a very pretty diagram to show how far he can go with a continuous current three-wire system for the same money as with the converter system. The very best answer, to my mind, to these figures, is to have Mr. Leonard's customers ask him to put in the installation at the prices he gives. We will, in such a case, give him the advantage of the difference in price of copper.

One feature of this figuring is something I do not quite understand; for instance, in Table No. 3 of H. Ward Leonard's paper, it is stated, "that with 30 volts maximum loss, the cost of copper per lamp for the three-wire system at 6,000 feet, would be $3.87. Then, in his analysis of this table, he calls this 6,000 feet "the average feeder length," and says this is equal to a circular area of 18,000 feet, or 3½ miles. How many times I have wished that the cost of copper for distributing our lamps was as elastic as this implies. Now, a radius of 18,000 feet circle is 9,000 feet. Mr. Leonard figures 800 feet between feeder terminals for his mains, and

1 Read before the Chicago Electric club, May 7, 1888.
The fifth of a series of papers upon the subject "The Continuous Current *vs* The Alternating Current," before the club.



Central Station 3-Wire Plant in Minnesota.—20% Drop.
(Reproduced from sketch accompanying Professor Badt's paper.



Requisite Pole Line for Central Station Plant in Minnesota, Converter System — 2½% Drop.

100 feet from the mains to the lamps. We will suppose that half this distance between feeder terminals, 400 feet, and the 100 feet for the service wires, are in a direct line with the feeder itself, thus making the feeder 6,500 feet. I would like to understand how the cost of wires for a lamp 6,500 feet away can be the same with the same system as for 9,000 feet away. The relative cost of the wire under such circumstances being as the squares of the distances, I make it out that the wire work for 9,000 feet costs about double that for 6,500 feet.

The continuous current advocates, try to scare away the alternating current with the cry of "danger." To attempt this at the present day, in face of the large amount of good work that has been done with high tension currents is about like trying to mop out the ocean with a kitchen mop. The people who raise the cry, with few exceptions, do it for a check on the alternating current, not because they fear the danger they portray. If the danger is such as to preclude the high tension system, we might as well stop at that point and not bother to figure on the cost, depreciation, etc., of high tension plants. Their remarks, and the practices of the companies some of them represent, show that neither of them fear this danger. They are kind enough to say they think the converter system might be used as an adjunct to the continuous current plant to reach outlying districts beyond the limits of their favorite, but limited system. If the alternating current is such a dangerous fellow, as they try to prove why should they advocate its use for outlying points, especially, when such points would consist largely of residences? I must ask them if they would distribute lamps around the family hearth for servants and children to handle, with a system that is too dangerous to use in stores and offices? The converter was developed on purpose to enable us to reach customers at a distance, and still have the e. m. f. at the lamps reduced to a harmless quantity. By systems of installations already in use, the secondaries can all be made absolutely safe. The danger then is reduced to the primary wires.

Dynamos of 1,200 volts are run on three-wire system. I must therefore ask a direct question. Is a 2,400 volt system of distribution continuous current, less dangerous than 1,000 volts alternating? If the tension of 1,000 volts is dangerous why install and advocate systems of 2,400 volts?

I feel that I must raise another point to show that fear of high tension is assumed for business policy, and not philanthropy. Suppose we do not adopt the policy of grounding the secondary, and some transformer leaks. The individual secondary is thereby subjected to the same tension to ground as the primary, provided, of course, that the other ground comes on the opposite primary wire. On this secondary circuit may be but few lamps that people could handle. This is probable. Therefore the danger of such a leak only exists in a few lamps.

Mr. Leonard says, the best method of distributing the electric energy from a distant point is with the motor generator. Two 1,200 volt dynamos to be connected in series and the circuit carried to the upper story of some building where the motor generators are placed. From this upper story the regular three-wire low tension system is distributed. Leave out the item of cost of the secondary system, and its limitations, but consider now the danger. If any one motor generator of the whole lot should leak, there would then be the danger of the 2,400 volt tension throughout the whole network. I quote Mr. Leonard, "The motor generator for this work is ready for the market but it has been learned that the cost per lamp can be very materially reduced by increasing the speed."

The alternate current converter is, as Mr. Kennedy well said, "The simplest piece of apparatus imaginable," and it has no moving parts whatever, no increase of speed, therefore the relative danger of leakage between the two converters is almost as one to infinity, in favor of the alternator. And still, the leak in the alternate converter endangers a few lamps only, whereas the leak in the motor generator endangers the whole network. Here is a company with able representatives facing their almighty dollar, and advocating a system in which a leak would give 2,400 volts throughout a network of wires, and then facing somebody else's dollar and crying "danger" against a system in which a leak gives 1,000 volts to a few lamps, and even that danger can be eliminated.

When Faraday was showing some experiments illustrating his great discoveries, and showed how simple it was to produce the electric spark with his apparatus, the dean said "he was sorry for it, as it put new power into the hands of the incendiary."

Gentlemen, when any new devices are put forth to the world, there are always people who cry them down for one reason or another and generally the cry of danger is raised, but our progress is not to be checked in any such a manner. These considerations lead me to believe that our continuous current friends do not fear the danger, or consider it should hinder our progress beyond the limited field of the continuous current. And, as I believe the danger of distributing electric energy by high tension alternating converter currents to be much less than the danger with gas, locomotives, steamboats, crowded streets, with all sorts of teams, and drivers, in fact, most of the methods and practices in crowded centers, I think we can proceed with the consideration of cost, depreciation, and revenue, to learn if the scheme is strong commercially.

I have also made another sketch, illustrating in a certain extent, the difference in the pole line between the three-wire system and the converter system; the large pole representing the pole in front of the Edison three-wire plant in New England, which was figured for 1,000 13 candle power lamps, the longest feeder in the system being 2,400 feet. My friend, who has charge of this installation, writes me that he is now using 980 16 candle power lamps, and therefore has not sufficient potential at the lamps. The company have decided to reconstruct the whole wire work this summer. There are about 10,000 lbs. of copper in the feeders and mains, and a nice little half ton more in the connections in the station. If the company were fortunate enough to buy this copper at the price quoted by Mr.

Leonard, they would have to pay about $1,600, provided they used bare wire, but in this instance they used Underwriters' wire, which of course, costs 25 or 30 per cent. more, owing to the extra weight.

Every installation of this sort requires a system of feeder regulators, which are a very expensive factor in the first cost. In this particular case these regulators cost about $1,200, which is 75 per cent. of the cost of copper for feeders and mains. Any comparison in the first cost between the two systems under consideration should include all these different items.

I also have pictured the necessary pole and wires for 1,000 16 candle power lamps, supposing they were all at a distance of 2,400 feet, which is much more severe than the three-wire installation pictured on the pole by the side of this one, and still you can all compare the difference. The alternating system requires no pressure wires because of the facility of making a voltmeter, which compensates for the variation in loads. As the alternator plant is operated with a very low percentage of drop, in this case I have figured on 2½ per cent. The difficulties of regulating for change of load are very slight, and the apparatus for accomplishing this, very cheap. Moreover, wherever regulators are used for alternating currents, they consume little or no power in doing their work,—just the reverse of the continuous current regulators.

As a probable improvement in the incandescent lamp was mentioned I would like to emphasize the fact that most makers of these lamps to-day are willing to guarantee about 25 per cent. better efficiency with the 50 volt lamp than with the 110 volt lamp, and the result of our experience in this direction thus far indicates quite decidedly that whatever improvement is made in the 110 or higher voltage lamp, will also give a proportional benefit in the 50 volt lamp. Briefly, then, the 50 volt lamp will probably always be 25 per cent. better than the 110 volt lamp. The importance of this difference in lamp efficiency is readily appreciated by all electrical engineers and by business men also, when they are able to sell 25 per cent. more energy with the same outlay for the plant.

The relation between dynamos and converters has been alluded to. This relation is only electrical, and not mechanical. Mechanical difficulties in a dynamo changes the electrical relations very materially. How we wish that the mechanical conditions would allow us to run our armatures within about one-hundredth of an inch of our pole pieces.

As I expressed myself quite emphatically in relation to the relative reliability of the alternating and continuous current installations. I will not venture upon this point, the situation simply being that with equal engineering ability, the converter system can be made as reliable, yes, more reliable than the three-wire system, because of the greater flexibility in the converter system.

As to the relative depreciation in the two installations, I would like to call attention again to the two pictures of the station in Minnesota, and ask any practical man which he would prefer to maintain for twenty years,—pole lines with a network of 54 wires, as shown for a three-wire system, or a pole line with 10 wires for the converter system and the converters. Is this depreciation that between pure copper and the converters? And when we get to placing our circuits under ground the relative depreciation will be decidedly in favor of the alternating system.

Mr. Lieb, the engineer in charge of the Milan station, has had considerable experience with the Edison tubes and Siemens cables, and also cables for 2,000 volt alternating system, and in a communication to an English periodical he says:

"How closely allied the question of underground conductors is with the future of electric lighting from central stations needs no demonstration. The local engineers do not claim that this difficult problem has been completely solved in Milan; but what has been done in that direction, thus far, makes it appear probable that no very serious difficulty will be met with in a general system of distribution of high tension currents by means of underground cables."

I have also made a picture of the underground conductors, full size, for 1,000 lamps on the 3 wire system 6,000 feet away at 10 per cent. drop, and the same number of lamps on the converter system at 2½ per cent. drop. If anything goes wrong with the large conductors and tubes, the street must be taken up for the repairs, whereas in the converter plant, the cables are drawn into conduits, as shown, which is the only proper method for underground distributions, and these wires can be withdrawn and new ones put in their places at comparatively small expense.

Just glance at that large plan and imagine the conditions under the surface of the street with all those tubes laying there like a gridiron barrier to any other work. The case shown is a mild one as compared with some places, where twenty odd tubes lay along a snug little strip twenty feet across.

The retardation caused by the iron in the neighborhood of the converter plant is of too slight a quantity to be considered at all in practice.

Early in my experience in making estimates for alternating plants, I wished to know whether I should make any allowance whatever for this retardation, and therefore, wrote to our people at Lynn for advice, as I knew they had experimented a great deal on this particular point. Their answer was, that I need make no allowance whatever, that in the installations they had made, they had never realized any loss from this cause. The figures certainly back up this assertion. A 40 light converter uses about 3⅓ horse power.

As Mr. Leonard quotes Bro. Kennedy as good authority on transformer work, I will quote him also, as he said distinctly that he "could use transformers with a loss of less than 2 per cent." My experience leads me to believe that this is correct, but I will take a loss of 5 per cent. mentioned by Mr. Leonard, which would give us a loss in a 40 light transformer of .16 horse power when running at full load. If empty, the loss would be much less than this. The primary wires for this converter have 2 amperes, passing at full loads through many convolutions placed very near the iron. As the loss in this transformer is electrical as well as magnetic (and probably largely electrical) the loss by retardation will be a small part of .16 horse power.

It is difficult to imagine a primary circuit of 1,000 light converter plant to be so situated in relation to the iron in the neighborhood, as to use up the same energy by retardation as is used in a 40 light converter when empty, which shows pretty conclusively that the retardation from this cause is too small a factor to talk about.

This diagram is intended to represent the relative energy of the continuous and alternating currents. By drawing all the waves above our zero line then draw a line along the top of the waves for the fifty volt line. The areas of all the waves show the energy of the alternating current and the areas between the two straight lines that of the continuous current, provided the alternating current has the same voltage as the continuous current. In that case the actual energy is much less then the continuous current. As the carbon cools very slowly and the waves are very rapid, probably this is very near the actual condition.

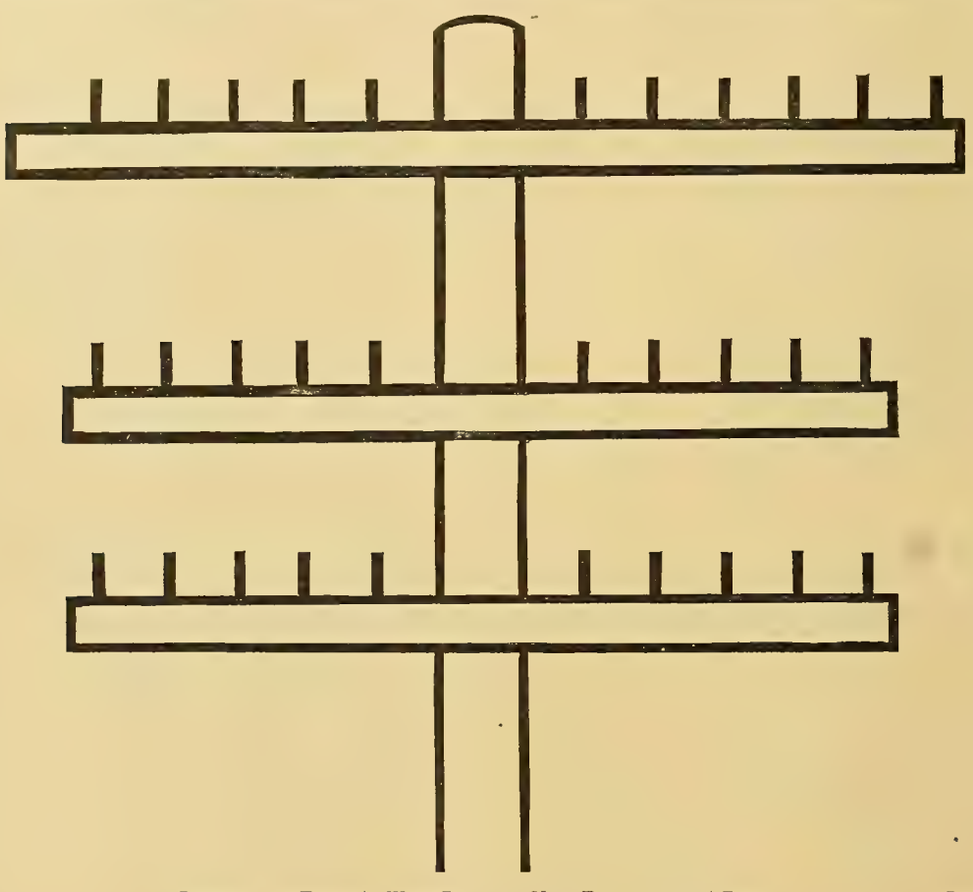
The heat of a 16 c. p. lamp 52 volts may average less on alternating currents than on continuous currents, and still the illuminating power be practically the same to the eye because the impression left on the vision would be that of the greatest brilliancy with the rapid changes of the alternating current. This indicates that the actual energy in a 16 c. p. lamp is less on the alternating current than on the continuous current.

I have touched upon the various points of first cost, economy, reliability, safety to life, etc., in rather a mixed up fashion, and now I come to the most interesting part, and the most important part of the whole question, that is, "Variety and value of the possible sources of revenue."

In distributing our energy we wish that system which will enable us to accomplish the most, and which will be readily adaptable to the various demands. Some business men may adopt a system that can only be used in a limited area, and that at an enormous expense. It is barely possible that Mr. Bliss touched the key note of this tendency on the part of some business men. We are all aware of the past relations of Mr. Bliss to the Edison company, and probably therefore, he is more or less conversant with the business policy of this company. In the discussion at our last meeting, Mr. Bliss said, "The capital that is being furnished for those stations [referring to the large Edison stations in Chicago and New York] comes very largely from the same persons who made the first installation of a large incandescent plant that was put into the United States." Possibly, these capitalists have some other benefits from their investments than that arising from the actual income of the stations themselves. That has often struck me as peculiar feature in the business of the Edison company which company is mentioned because of the large amount of work it has done with continuous currents, and because they are about the only large concern that tried to close the door against the alternating current, viz: the capitalists who furnish the necessary funds for the largest Edison plants in different parts of the world, are interested in the sale of similar installations elsewhere; possibly they look to these sales for the reward or profit on these large central plants that have been put in at such an enormous expense.

As Mr. Bliss has promised a paper on the continuous side of this question, I certainly hope he will give us figures that will enable us to understand how the dividends can be paid by the actual earning capacity of large central stations of the continuous system, not only because I wish to know positively that these enterprises are a sure success, but also, for the benefit that such demonstrations will be to the alternating side of the question, because if that will pay which is so limited in its capabilities, we can certainly feel sure that another installation furnishing the same class of energy can pay still better by virtue of its greater flexibility and almost limitless possibilities.

In the discussion which followed the reading of Mr. Leonard's paper, this gentleman stated that the "cost of operating and maintenance of any system is certainly reduced if they can operate from one source of supply."



POLE FOR AN EDISON 3-WIRE PLANT IN NEW ENGLAND.—20% DROP.

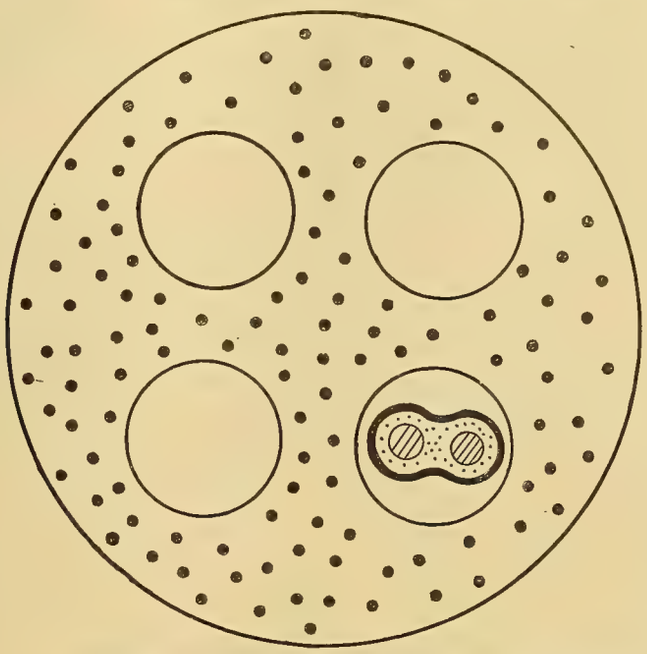
POLE FOR CONVERTER PLANT OF SAME SIZE.—2½% DROP.

Thus, showing that he does not believe in various stations for supplying energy to a large city. The remark was made as applying to central stations, but it appears to me to apply also to accumulator stations, because they must be operated on low potential, therefore, there must be many of these accumulator stations, each one of which is of necessity equipped with many and varied devices for regulating the feeders, etc. That attempts are being made to run lights from accumulator stations, we are all well aware, and hope, of course, that they will prove a success. but that remains yet to be proven. When they are perfectly developed, and supplied with all the regulating devices above mentioned which appear to be necessary, the possibilities of profit may disappear, and I am free to admit I am afraid they will.

bination of low potential and high percentage of loss, means constant attention to the regulating devices, that is to say, every one of these secondary stations embraces more or less the difficulties of the present continuous current station. And, further still, the secondary network can give but a uniform electrical condition *theoretically*, therefore your continuous current, whether it is of the 3-wire system, multiple series system, continuous current converter system, or accumulator system, is limited, and very much so, in its possibilities. Any use of them at all, requires high engineering ability, and the very best of engineering ability can only accomplish a limited amount of work.

The alternating current is entirely a different sort of fellow ; extremely flexible, and unlimited. It enables us to

Edison Tubes for 1,000 Lamps at 6,000 Feet.—Loss 10%.



Conduit with Primary Wires for 1,000 Lamps at 6,000 Feet. Spaces to Draw in Cable for 3,000 additional Lamps.—Loss 2½%.

The idea of converting our energy seems to be the prevailing idea of to-day, and our electrical journals are filled with illustrations, paragraphs, figures, etc., about some sort of a converter system, alternating converter, continuous current converter, accumulator converter, each one trying to prove that his especial system of conversion is the best. This is interesting, as it shows pretty conclusively the general feeling that the continuous current of itself, is altogether too limited in its possibilities for the work that we have in hand all over the world to-day. Our industry is growing, and people are not satisfied with working within just such prescribed limits. Hence, the various devices that enable us to go beyond these limits,—and the alternating current seems to be just the thing wanted for the purpose, as it does its work in a manner not accomplished by any other converter system.

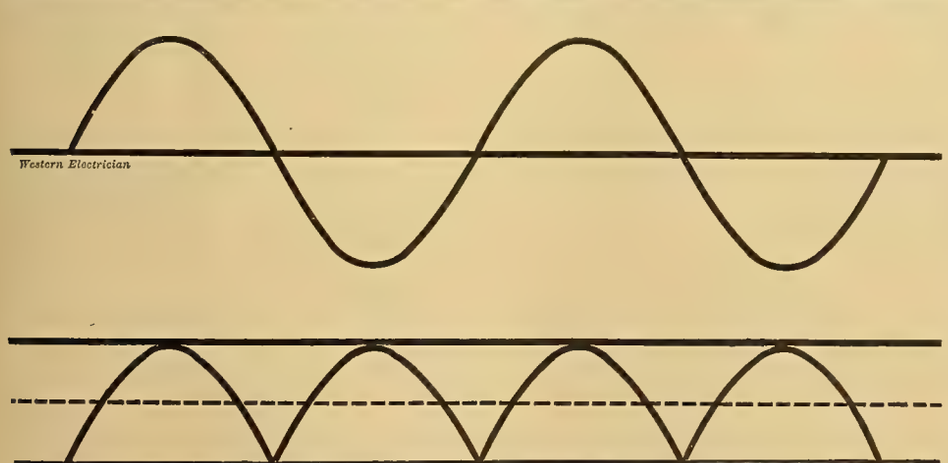
Admitting that the continuous current converter may be made quite a success, it still can never be placed about town in all sorts of situations, and of all sizes, as can the alternating current converter. It is a machine more or less difficult to keep in order, being, as Mr. Leonard says, "run at a high speed," that necessarily means constant watching. Therefore, these converters must be used in secondary stations with low tension system distributed from them. This is also the case with the accumulator. It also requires a great deal of attention, and if used for central station distribution, must be placed about town in secondary stations. As the network from each secondary station is low tension, we must still work on high percentage of loss, in order not to have too many stations, and this compare current motor is certainly further advanced to-day than was the continuous current motor when the work commenced with the continuous current distribution, so we will soon be able to rent power from our alternating network, provided it is found a matter of policy to do so from the electric lighting circuits.

There are other industries now before the world which certainly bid fair to become of great importance, and as one department has been pretty well developed, I will allude to that more particularly, and that is, the welding and manipulating of metals by electricity. I have been fortunate enough to secure a number of samples of metals welded in this way, showing that I am not dealing in "futures" when talking of this industry. There may be a large source of revenue to central stations that are providing alternating currents, in furnishing the energy for this class of work. As it may be said that the continuous current is also being used for the welding of metals, I must say that this method has not proven a success, having seen the operation in a large workshop in Paris, where they tried to make oil tanks by welding metals together with a voltaic arc ; I know that the method is not at all a practical success as yet, as the metal is oxidized and destroyed, burnt up so to speak, by the intense heat.

The continuous current can be used for electric welding, but as enormous quantities of current are required, the dynamo supplying the same must be near the work. This limits the continuous current very much for this class of work. Not so, with the alternating current converter. We can attach to our two little wires a very small converter for jewelry work, or a very large converter for heavy welding.

Another feature of the question is this, it is easier to work the registering meter on the alternating current than on the continuous current. The difficulty in this class of meter lies in the fact that they must record in proportion to the number of lamps burning, or the amperes used, whereas the work done is, by itself, in proportion to the square of the amperes. This difficulty is quite easily met in the alternating current, by the use of a simple kicking coil, but it is not one easily met in the continuous current.

I have made a diagram [page 239] illustrating the subject of my paper as a final summary of what I have tried to express. I think it shows pretty conclusively what my title implies, namely, the continuous current limited vs. the alternating current unlimited. On the left I have pictured two large wires for carrying 1,000 amperes and 125 volts, which you will see equals 125,000 watts. Connected to these wires I have represented an accumulator, motor and an incandescent lamp. I do not mention time circuits, telephone or telegraph, as I do not consider them worth bothering with in an electric light station. These different factors are all necessarily 125 volts, not more or not less, simply limited to that phase. On the right of the drawing I have represented two small wires for 1,000 volts and 125 amperes, which is equal in energy, namely, 125,000 watts, The wires for this current are one-quarter the diameter of the others. I have represented, as connected to this circuit one transformer, operating 52 volt lamps, one operating 110 volt lamps, one giving 20,000 volts, another giving 20,000 amperes for heavy welding, one giving 500 amperes for jewelry welding, and I have also Professor Thomson's method of charging the accumulators on alternating currents, and I have a motor. Here you see are two circuits side by side conveying the same energy, one of which gives us fixed e. m. f., and the other gives us almost any e. m. f. or quantity we wish. To carry the continuous current of such a quantity, 1,000 feet with a loss of ten per cent., we would need copper rods two inches in diameter, whereas, the other current can be carried at greater distances on a very small wire.



Relative Energy of Continuous and Alternating Currents.

couple of wires in our rooms which will furnish 110 volts and no more or no less, we have a couple of wires which will furnish any voltage, or most any quantity desired, so that if a new industry should arise where 8,000 or 10,000 volts are required, two little wires carrying the alternating current, will furnish the energy which can be converted to this potential. Or, if a very large quantity is desired of low potential, these same two wires will furnish it.

For the rental of lights alone, the general impression has been, that the alternating current can do it satisfactorily.

The work of motors on the alternating current has been discussed sufficiently before the club, therefore we will await further developments in this direction. The alter-

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Vice-President Brown : Gentlemen, the paper is now before you for discussion, and I will be glad to hear any remarks upon it.

Mr. Bliss : I move a vote of thanks be extended to Mr. Cutter for his very able and interesting paper.

The motion was carried.

Vice-President Brown : We expect to hear something from Mr. Leonard.

Mr. Leonard : I have so many points jotted down that I hardly know where to commence. One thing struck me as particularly happy in Mr. Cutter's paper, and that was his frequent characterization of the alternating current system as a "fellow." I think if I remember Mr. Webster's interpretation and definition of the word, the use of the term was quite appropriate.

The first point I have jotted down is hot water and electrical distribution as being comparable ; I think that is assuming a great deal. In the distribution of steam power by means of water at high pressure, or high temperature, there would be an enormous loss, due to the loss of latent heat of the water by condensation. No such loss as that of latent heat exists in anything electrical.

Mr. Cutter touched upon my first paper as being biased, and seems to assume as one of the other papers have that in my paper I did not leave any place for the converter system. My paper was entitled I think, "The value of the continuous current *vs.* the alternating current." I thought I made myself clear in my paper, that I believe in the future of the continuous current converter for the transmission of electrical energy over long distances ; if I did not say so I wish to emphatically state it now.

I was unfortunate enough to be called away on important business on the very day that Professor Badt read his last paper, so that the picture of the St. Paul station, which has been before us, I was not able to comment upon. I have seen the St. Paul station, and I did not have the same difficulty when I was there in seeing the building in the background that I have in the diagram here. The professor has found 54 wires at St. Paul ; that may be so, I am not exactly familiar with the number of wires. But I saw in a similar station that we carried our energy at a much farther distance, probably twice the distance that

(*Continued on page* 239.)

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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EASTERN OFFICE, 30 TEMPLE COURT, NEW YORK.

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Notice to Subscribers.

Subscriptions to the WESTERN ELECTRICIAN, weekly, at $3 per annum and *The Electrical Engineer*, of New York, monthly, at $3 per annum now filled from this office at $5 per annum for both journals.

AGAIN we take the liberty of devoting a few words to ourselves. At certain seasons of the year, both before and after the great conventions of men interested in electrical progress, unusual demands are made upon us for space in reading and advertising columns, and at those times the WESTERN ELECTRICIAN largely exceeds its customary number of pages. Last week we had the pleasure of presenting our readers a paper of thirty pages, containing all the matter the printer could crowd into the forms. This week we have been compelled to add two pages more, making the total number of pages in this issue one-third more than the number we have been in the habit of printing. The demand upon us at this season of the year, especially when no extraordinary effort has been made to increase the size of the paper, speaks very well for the state of the electrical business and of the WESTERN ELECTRICIAN as an exponent in the west of that business.

The subject matter of the paper this week is well assorted and very comprehensive, and he must be very hard to suit who does not find in the reading columns an article, illustration, a bit of news, a new idea, thought or suggestion that is interesting and of service. The details of a new electric lighting system are shown; an illustration of a new incandescent lamp socket is given; the Waterhouse self-regulating dynamo is described; an exemplification of the use of the electric motor follows; then comes Mr. Cutter's able paper upon the "Alternating current unlimited," liberally illustrated with cuts reduced from the drawings presented before the Chicago Electric club; Mr. Lockwood continues his admirable article on "Practical telephony," and besides all this there are several pages pregnant with newsy notes of what is going on in the electrical world.

This issue of the WESTERN ELECTRICIAN in respect to its "make up"—to use a typographical term—is a fair illustration of our idea of what an electrical paper should be It is not so technical or scientific in character that it cannot be read save by electricians; on the other hand, it is not so light that the electrician cannot read it with profit. To the lay reader, the student, the electrician, the scientific man, the dynamo tender, the clerk, the business manager, the salesman, the purchaser, the advertiser—in fact to readers all over the United States, Great Britain, France, Germany, Belgium, Italy, Sweden, China, Japan, and far off Australia this paper goes with its record of the electrical accomplishments and electrical news of the week.

THE midsummer meeting of the National Electric Light association will be held at the Hotel Brunswick, in New York, August 29th, 30th and 31st, this being the decision of the executive committee at a meeting held last Friday.

IT is said there is danger in the decree of the Spanish government that all theaters must be lighted by electric light. The new illuminant must be adopted within six months. There are not electricians enough in the kingdom to see that the work is properly performed and if there is an influx of experts the danger will be that the installations will be hastily and poorly made.

FOUR manhole covers over the underground conduits were blown off by an explosion last Monday in Chicago. It is supposed that the explosion was caused by the mysterious ignition of gas which had collected in the conduit. Commissioner Swift says that he proposes to institute an investigation as the explosions are becoming such frequent occurrences.

THE office of *The Progressive Age* has been removed from Philadelphia to New York and the paper hereafter will be issued as a semi-monthly instead of a monthly. *The Progressive Age* is an able paper and has thoroughly covered the range of gas topics to which it has devoted its attention. The present prosperity of the paper is manifest; consequently we can do no more than wish for it a continuance of its prosperity and a maintenance of its standard of excellence.

THE promise that Mr. Cutter would prove an an able advocate of the alternating current in the argument "The continuous current *vs.* the alternating current" has been fulfilled, as a reading of his paper in this issue will show. Mr. Cutter outlines his position on the start, i.e., he believes the alternating current unlimited and regards its outlook as much better than that of the continuous current. Even a summary of the the points he makes is quite of the question and it must suffice to simply call attention to the great flexibility of the alternating current as exemplified by the illustrations on the opposite page.

THERE have been within the last two weeks an unusual number of fires caused by electric light wires. The reports that the daily papers give are of too general a character to indicate in just what manner the fires originated. The necessity for careful work is emphasized by these conflagrations. Unless English journals are mistaken there is too much careless wiring in this country. There is just this to be said in reference to fires attributed to electricity: As country correspondents always infer that every blaze is the work of an incendiary so their city brethren infer that most mysterious fires originate from electric light wires. It is more reasonable to account for a fire in this way than to suppose spontaneous combustion even if the supposition is no nearer the truth.

TRAIN LIGHTING by electricity is steadily progressing in the west. The latest instance is a vestibule train of the Atchison, Topeka & Santa Fe railroad. The light is furnished by an incandescent dynamo which occupies a corner of the baggage car and which is run by an upright engine taking steam from the locomotive. The train is also heated by steam. With the electric light for an illuminant, steam for heating, a vestibule between the ends of adjoining cars to keep out the dust, to do away with danger in passing from one car to another and to largely decrease the possibility of "telescoping" of the cars in case of a collision, the traveler's life is made very pleasant.

This installation of the electric light will be watched with interest, inasmuch as it is to be operated under difficulties not ordinarily met.

IT is not often nowadays that a good word is said for the much abused telegraph poles. In the recent fire which destroyed the offices of the *Daily Leader* and *Homestead* at DesMoines, Ia., the employes found it impossible to reach the ground by the stairway as the flames barred the way. They took to the roof and by some means reached the poles down which they slid safely, if not gracefully, to solid ground, amid the cheers of an admiring throng. The accounts state that they received numerous electric shocks en route but no explanation of these phenomena is vouchsafed. A few days later the cornice of a building fell without warning on a crowded street in Chicago. Fortunately the heavy mass lodged in the telegraph wires. Had it fallen to the street several persons would have been maimed if not killed. It is a pleasure to credit the much maligned pole for its services in saving human life in two instances within as many days.

THE New York papers are demanding that as a measure of precaution the wires in the metropolis be put under ground at once. The New York *World* recently sent an expedition of three men on a tour of investigation. They examined several electric light circuits. Their report, which fills three columns, is of an alarming character. It is true, of course, that the investigators started out to prove that the wires were in a bad condition and, of course, they found evidence in support of their position, but if even one-tenth of the article is reliable and the remainder exaggeration, there is still reason to believe that no little danger exists. They found the insulation in bad condition, the wires were insecurely fastened and the arrangement was such that crosses between telegraph and telephone and electric light circuits were liable to occur at a hundred different points. The *World* says that the dilemma is a simple one, "either the wires must go under ground or some of the inhabitants." This is undoubtedly putting the case too strongly, but the matter is one which may well commend itself to the careful attention of New York companies.

A NEW YORK coroner's jury has found an electric light company responsible for the death of a lad by a shock from the wires. Two deaths from this cause have occurred in New York city within a month, but it is only fair to add that the whole number of deaths attributed to this cause is only seven within the last five years. In the case in which the company was censured the lad took hold of a wire which was dangling from a pole and, in some way, it is not easy to see how, received a shock which caused his death. The accident which caused the death of the Bowery bookkeeper was the result not of any company's carelessness but of the unfortunate man's own foolhardiness. Still the accident has been productive of the usual number of flings at the electric light. It will be remembered that the unfortunate man lost his life in attempting to regulate an arc lamp in utter disregard of the repeated orders of the company's superintendent. Yet a correspondent in a New York paper urges that the president of the company be prosecuted for manslaughter. This is on a par with the majority of remonstrances against electric light companies. It is scarcely more absurd than to call upon grand juries to indict officers of gas companies because rural visitors are suffocated in hotels as a result of blowing out the gas.

(*Continued from page 237.*)

they did at St. Paul. There were 18 wires, which were about No. 12, hard drawn copper.

At Oskaloosa we have a system which is operating 3,000 ncandescent lamps. We have $8,000 worth of copper, based upon the figures of to-day; it cost us very much less than that, as it was bought when the market was about 13 or 14 cents. Our copper for that station has cost us, as I say, including mains, feeders and everything in the shape of copper except the inside wiring, $8,000; converters for 3,000 lamps at a less figure than I ever heard mentioned, would cost $9,000, without taking into account the feeders, mains, and the necessary labor for setting up these converters, etc. The pole line of course is much heavier than would be required by the alternating system.

Mr. Cutter has criticised my statement, that the average length of a feeder of 6,000 feet corresponded to a circular area of 18,000 feet diameter. It might perhaps be a little difficult to demonstrate this verbally. This is naturally only a question of determining the center of gravity. Where would the center of gravity be located in the sector of a circle which had 9,000 feet radius? I think it would be evident that the center of gravity is two-thirds the way out from the center along the radius.

Mr. Cutter talks of the use of the continuous current converters, for outlying districts, and the danger which would accompany the use of such converters. Of course in my paper I only mentioned the converter which the Edison company have among others which are probably in this field. In my paper, however, I was particular not to mention the motor generator, as the only possible converter or mode of conversion as it is far from being the only one.

While in New York recently, I had occasion to spend an afternoon at the Edison laboratory and was very much interested in watching and learning the result of a test of the continuous current converter, in which no iron and no copper was in motion, and in which the electrical conversion was occasioned by the motion of the lines of force at an enormous speed. As to the danger of a cross between the primary and secondary of a motor generator, I think, Mr. Cutter cannot be familiar with the construction of the piece of apparatus. A cross of any character in a motor generator immediately robs the field; the danger is absolutely hypothetical.

this so often that I imagine it now comes from me as a good deal of a "chestnut." Every converter is to be run from its maximum load to its minimum; therefore, the efficiency of the converter at full load is an extremely important factor in the efficiency of the system. Of course this has been mentioned heretofore and the statement can not be challenged in regard to a leak in the converter. I happened to be at Richmond where they were operating and constructing an electric railway. The railroad was deriving its power from the station, and in the same station was a Westinghouse alternating current system I asked him where the converters were and how they worked; the reply was that they burned out about twelve or fourteen. The gentleman I asked was not quite sure, but he thought they were burned out and in regard to the armatures he was not quite sure if he had not burned out one or two. The motor Mr. Cutter left to the future. At Richmond, of course, there was a very practical illustration of the means of operating anything by way of motors.

Of course, we all recognize and agree with Professor Thomson, that there is a very large field open for welding by electricity, and that electricity may be used, to a very large extent, for this purpose. But while the alternating current is well adapted for this purpose, there is no reason why the Edison system, operating 100 or 200 volts, by using an interrupter could not be able to reach results exactly of the same character obtained by adding to or taking from the number of volts. Therefore, I do not think we are unable to secure the same results, in the way of welding.

The last diagram, which Mr. Cutter says shows a 16 candle lamp attached to a one inch rod, is not important in my estimation. It shows vast possibilities, to be worked out in time, in the alternating system, which would give them plenty of thought for a long number of years

MR. CUTTER: I still am unable to explain how the lamp which according to Mr. Leonard's explanation would have been 12,000 feet from the station instead of 9,000, because he said that the 6,0 0 foot feeder was equal in relation to the distribution over a circle of 18,000 in diameter. Now if he moves his center of gravity two-thirds out from the center then how he is to come up to the center? How he can do that I can not understand, without moving the full distribution of the lamps.

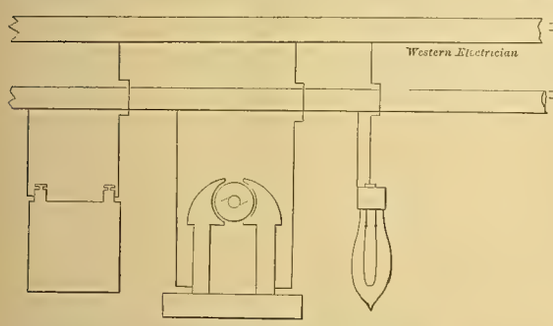
current you would not operate the maximum load more than 1,000. Quite recently there have been some very important tests conducted, I have forgotten who made them, but I remember of reading them recently. It was a matter of determining whether there were any possible differences between the energy taken by a lamp of one candle power in the alternating current and the continuous current systems, and the result was there was hardly any difference. It has been published quite extensively, I have read it within the past six weeks. As to the diagram as I have before indicated it does not portray the actual condition of affairs. And as to the sine curves, there may be sine curves representing the curves of energy of the alternating current, but it is almost universally limited. The sine curves would represent the energy of the alternating current of the theoretical generator, but it does not represent the curves at least if I understand it that way. I therefore think that the diagram is incorrect.

MR. CUTTER: I would like to explain in making that pure sine curve I did it because the best authorities which I could find upon the matter consider that the curves in the alternating current would be pure sine curves especially if the coils were in the circuit; it had the element of self-induction.

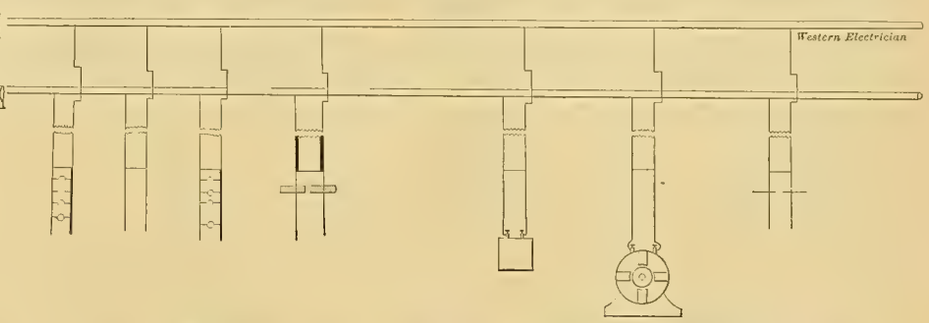
MR. LEONARD: I think it is almost impossible to argue a point of that character, because Mr. Cutter has indicated one of the principal features of the alternating system, and I do not think that is right.

The Skrivanow Primary Battery.

The attempt which was made in the early part of 1885 to destroy the Houses of Parliament by dynamite led to the introduction to public notice of a new search light driven by a primary battery, and designed for use in small boats on rivers, says a writer in *Iron*. It was introduced by Isidore Spielmann, who about the time stated experimented with the apparatus, which was in the first instance intended for the use of the river police in patroling the Thames opposite the House of Parliament. The object was to throw a strong light from the middle of the river on to the palace of Westminster. The difficulty to be overcome was the obvious one presented by the size of the police boats, which does not admit of their being fitted with engines, dynamos or bulky accumulators. The only source left was that of the primary battery, and from this was derived the light with which the trials were made. The battery used was the invention of George de Skrivanow, a Russian inventor, who died about that time. The elements of this battery consist of a small packet of chloride of silver and two plates of zinc placed in each cell with a weak solution of caustic potash. In applying this battery to domestic lighting, a small one is placed in the stand of a moderator or other similar kind of a lamp, which can thus be utilized for the purpose, a glow lamp being fixed on the top in place of the ordinary burner. The author inspected a number of lamps thus arranged. Taking one lamp as a typical of the rest, he may explain that it had a battery consisting of three boxes, each measuring only 4x2x1 inches, and which supplied the current to a glow lamp of Italian manufacture, the light being an exceedingly good one. It was stated that it would burn for twelve hours with undiminished brilliancy, but at the end of that time the silver would be converted into pure silver, and would require to be revivified. This is effected by washing it in a solution of nitric and hydrochloric acid. It is then replaced in the battery for further use, there being no waste of the silver. The marked advantage of this system of domestic electric lighting, beyond the portability of the lamps, are the absence of fumes, the small battery capacity and the great electromotive force, this being 1½ volt for each cell, which is only one inch in width.



CONTINUOUS CURRENT CIRCUIT OF 1,000 AMPERES AND 125 VOLTS CONNECTED TO ACCUMULATOR, MOTOR AND LAMP.



ALTERNATING CURRENT CIRCUIT OF 1,000 VOLTS AND 125 AMPERES CONNECTED TO 52 VOLT LAMPS, FURNISHING 2,000 VOLTS FOR ANY PURPOSE, 110 VOLT LAMPS, 2,000 AMPERES FOR HEAVY WELDING, CHARGING ACCUMULATOR, CONNECTED TO MOTOR, FURNISHING 500 AMPERES FOR JEWELRY WELDING.

I noticed in the sketch he refers to a 20% drop in a system in New England. I am familiar with the Edison system in this country; I doubt if there is an Edison three-wire system in the east, which has a 20% drop.

Mr. Cutter places a great deal of stress upon the subject of engineering ability. As to the electrical engineering ability, no doubt central stations of any size require a man of sufficient brain to operate the feeders of the station, and any man of sufficient knowledge to operate feeders properly would have no difficulty in figuring abstruse problems. Now, we have no difficulty whatever in educating our ordinary foremen, and they are drawing very moderate salaries, and they can figure a three wire system down to a result so that it will have to be just merely checked over by us to give us the correct results.

As to undergrounding of the wires, the Denver station has been running all this time, and it was put down with the idea to see what effect the rust would have upon the energy. I also happened to have a conversation with the superintendent of Siemens, abroad within the past few days, and he states that in Berlin—I think Berlin, or some town in which they recently had an Edison installation on a three-wire system—they laid their conductors three years ago, and from that time to this they have never had occasion to break the ground to repair any of the conductors then laid.

Mr. Cutter has endeavored to show us or to prove by that diagram on the left [indicating] that the energy required for lamps on the alternating current is less than that of the continuous current, because the areas in these two diagrams are such that they are less in the alternating current than in the continuous. This reminds me of the days when I was a boy, studying geometry. It is the *reductio ad absurdum* when he reminds me that these diagrams represent the exact difference between the space for the alternating and continuous current. That, to any person's mind, is evidently absurd. One thing I think he has proved is this: That these two curves do not represent the energy of the alternating and continuous current systems.

He speaks of the effect upon the eye due to the heat cooling. If we are going to work by the effect upon the eye alone, possibly there may be some ground for that, but if we are going to work upon the actual illumination of a room and not by the lamp itself, then I think that any such argument is very slight.

I think Mr. Cutter has also passed over what we think as an important part in the operation, and that is the efficiency in the condition of the converter. I have said

MR. LEONARD. Where would you assume the center of gravity in such a system?

MR. CUTTER: Assuming this an equal distribution, then it would be in the center of the circle.

MR. LEONARD: The problem resolves itself into a large number of sectors of circles. The center of gravity would be two-thirds out from the center. The sector would be, therefore, able to supply 6,000 feet over the length of the entire circuit.

MR. CUTTER: Then I understand you do not stop two-thirds out from the center.

MR. LEONARD: Not at all.

MR CUTTER: I cannot understand it. Another point Mr. Chairman, in relation to the danger of the motor generator. I understood distinctly they were both run in the same armature and provided he has eliminated the danger as nicely as he portrays, I would like to understand how the escape comes through there. I still think my remarks with regard to the 2,400 volts will exist—the danger will exist throughout the whole network, when there is a leak of any kind between the primaries and secondaries in any one of the motor generators in the system.

The station I spoke of in New England, was calculated for 1,000 13 candle power lamps and I know very well that capitalists would be very well pleased if they could run the maximum 1,000 lamps in that station.

In relation to the diagram which I made to represent the relative energy of the two systems, I look upon it as the most interesting I have made, because I am free to admit I would like to know what energy the current has.

MR. LEONARD: The first point Mr. Cutter mentioned was the relative danger of a cross between a primary and secondary. In his paper he mentioned a cross in the motor generator might be more liable, but a cross in the motor generator robbed the field, and the entire condition would be changed. The machine would immediately run right down and the strips would blow. As to a cross between the primary and the secondary on the poles of course any such cross as that would be similar to a cross between the primary and secondary on the converter system.

Relative to the capitalists in New England, I did not state that the station would supply the maximum load 1,500 lamps. I said it would operate 1,500 lamps, connected under ordinary conditions. If the converters were placed, they must be so placed that each one of them may be, at the same time capable of supplying its maximum number of lamps. Therefore you would have two converters of 1,500 lamps while probably as in the continuous

Practical Telephony.

PART IX.

By Thos. D. Lockwood.

There does not seem to be much more to say with respect to the construction and operation of the Blake transmitter. It remains to speak of the faults which do or may develop in it.

If everything else connected with the apparatus and line is all right, and the transmission is weak or is reported weak, the most probable cause is that the user stands with his lips too far away from the mouth-piece. It is one of the noticeable things about telephony that the average user either wants to shout at the transmitter, or he won't speak loud enough; and that if he does not attempt to climb in the mouth-piece, he will stand at the full length of the cord away, and turn his lips to the other side of the room. Therefore it is always a safe proceeding to find out the *modus operandi* of the complainant before making any change in adjustment. If it be found that the part of the user is faithfully performed, it may be that the contact between the carbon button and the platinum contact piece is too tightly adjusted, or that both are too tightly pressed against the diaphragm center by the adjusting screw and lever. In either case the proper remedy is to cautiously let down the screw. With a little practice one may easily acquire the ability of testing for this fault without any one at the other end of the line to listen; that is the ability to test by what is called the side tone alone. To do this, the rule is, "Hold the hand telephone to your ear with your lips about three inches from the front of the box; speak in an ordinary tone of voice articulating plainly; then utter a sustained fairly loud musical note." If the transmitter is all right, after some practice you will hear the conversation or note in your ears and can readily judge of the condition of the instrument. If upon starting to adjust, the side tone comes faintly, screw back a little, until it returns clear and loud. Occasionally, and especially in hot weather, the rubber ring surrounding the edge of the diaphragm gets viscid or sticky, and develops a tendency to stick to the ring-seat or frame. In this case it is only necessary to gently loosen it all round; and it may be well to rub a little fine chalk over the rubber surface, so as to absorb the stickiness. The same trouble will occasionally develop at the end of the dampening spring where it presses upon the diaphragm. This is not however frequent, because for a number of years it has been guarded against by the manufacturers, who cover the end of said spring with a little piece of cloth. The speech instead of being weak may be too loud, or while just loud enough may be shaky or indistinct. This is caused usually by the adjustment being too loose, in which event the instrument while working properly as long as spoken to very softly, produces an unpleasant buzzing and rasping sound which blurs the words and distorts sentences. A half turn inward or less will usually remedy this fault. Sometimes the same trouble arises because the point of contact between the carbon and platinum is not perfect or has become dirty. If the first action does not remedy the trouble this should be looked to, and any such imperfection thoroughly remedied. A radically bad carbon button should at once be discarded. If the polish has worn off, or if the surface has become rough or frayed; there is no better way for an inspector to repolish or re-smooth them, than to vigorously rub the faces of two buttons together. By this process they can be made very smooth and bright. What I mean when I speak of a radically bad carbon, is one which is spongy or honeycombed, and upon which it is impossible to produce a smooth and uniform surface. Or it may be that the transmitter refuses altogether to speak. What then? In that case it is pretty safe to say that either the main or the primary circuits are practically open at some point. The first thing to do, is of course to find out which circuit is at fault, and that being done it is an easy matter to locate the break. This, however, is a matter which I shall deal more fully with a little later when considering troubles which affect the telephone outfit as a whole. It may be said here that in all such cases it is well to keep a weather eye open for the corrosion due to superfluous acid near the hinge connections and binding screws, and for loose screws everywhere, for though every precaution is taken in inspection after manufacture, as long as ships are but boards, and sailors but men, so long faults will occur resulting sometimes from the negligence of the mechanic making the machine, and sometimes from that of the inspector who passed it.

The Transmitter Battery.—From the microphone transmitter itself, we progress naturally to the battery that works it. Various types of battery have been and are used; but the Leclanché type and its analogues are more used than any other. It does not seem requisite in this series of papers that I should discuss various forms of batteries; as the subscriber uses what is given him, and as what is given him is either the disque or prism form of Leclanché I will confine my attentions to these calls.

One cell is generally employed and one cell is generally enough. The disque Leclanché cell has a porous cup and the prism has none, and this I think is the main distruction between them. I don't know why the "disque" is called the "disque," and I don't think any one does. Probably it is a kind of trademark.

No greater mistake can be made with any open circuit battery than the use of a cell which is of small size. Good results will invariably accrue from the employment of as large a style as can be obtained and got into the battery box; because the "hold-out" of the cells depends as much as anything upon its size.

It is customary for text-books and manuals of electricity when speaking of this battery, to say that its elements are carbon and zinc. This statement is quite incorrect. The two elements are zinc and a mixture of peroxide of manganese, and crushed carbon, a combination giving a higher electro-motive force in a solution of sal-ammoniac (chloride of ammonium) than a zinc-carbon couple. The only use of a porous cup in this Leclanché cell is to hold the mixture loosely together. Therefore, it cannot be too porous; and many otherwise first class cells have proved very poor in practice, simply because the fluids could not readily pass through the wall of the porous cup. If then it be found upon examination of any particular cup, that its material seems in the slightest degree hard or glazed, it should before being put into use, have a number of holes bored through the side, so that the sal-ammoniac solution can freely circulate throught it. A carbon plate is placed in the center of this cut, and fitted with a lead cap surmounted by a screw-post. All round this a mixture of peroxide and crushed carbon is loosely but firmly packed; and the top of the cup is than sealed over with a pitchy mixture; a pair of small glass tubes being first placed, so that the pitchy mixture will surround them and hold them in place. These being open both inside and outside of the pitch afford a chance for the gases generated to escape. The bore of these pipes is or should be wide enough to admit the passage through them of an inspector's small screw-driver. Sometimes the pipes are dispensed with and holes are left through the pitch by letting the latter flow round small rods, which are withdrawn as soon as the sealing cement stiffens. It is not material how the holes are made, provided that they are made, and that they are clear from end to end while the cell is in action. It always pays to buy first-class porous cups for Leclanché batteries. The manufacturer who sells a battery a good deal cheaper than anybody else, is very apt to get square by putting in a smaller amount of peroxide of manganese than anybody else. The recuperative power of the Leclanché cell is largely dependent upon the amount and quality of the manganese peroxide that is in it. Hence the necessity of having the best. Some, reading this, may be inclined to say, "What is the use of telling us that? We don't have anything to do with the buying." My friend I know you don't. Very likely you knew this as soon as I did, but your fellow inspector there doesn't and it won't hurt him or you either to know it, simply as a portion of your common stock of knowledge; and in the second place, it is a good thing to be able to give a good and correct reason why cheap batteries don't stand up very long. Give your reasons often enough and by and by they will carry conviction to those who do the buying.

The peroxide of manganese is a pretty good conductor, and contains a great quantity of oxygen. So it is not only advantageous as being a long way from zinc in the chemical scale and thus adapted to generate a strong current, but parting with a portion of its oxygen, it also enables the cell after being used a long time to recuperate by the combination of the said oxygen with the hydrogen generated during the action of the battery; which hydrogen would otherwise coat the central carbon plate and the conducting surface of the conglomerate mixture and greatly interfere with the proper working of the battery. But as the oxygen of the peroxide attacks this free hydrogen, it is innocuously converted into water.

The sal-ammoniac solution should be kept strong. All sal-ammoniac is more or less adulterated with iron. I have not found a small amount of iron harmful. The solution ought not to reach more than one-half the height of the porous cup after the latter is soaked, as the cell works better when the upper part of the contents of the porous cup is dry. The small paper bags of sal-ammoniac which accompany complete new cells, contain just about the right quantity; this can be noticed and measured for future reference, but it is always a good rule to put in sal-ammoniac until the water will dissolve no more.

The zincs used in this battery ought always to be—but hardly ever are—rolled. The rolled zincs work much better, and last much longer, than cast zincs do.

When the Leclanché battery has worked for a while, it generates a number of zinc salts, a crystalline mixture of ammonia and zinc chloride, and two oxy-chlorides of zinc. These are soluble in a saturated solution of sal-ammoniac, but quite insoluble in water, and this, therefore, is the reason for keeping the solution saturated. The formation of bright crystals on the zinc is a never-failing sign that the sal-ammoniac solution is exhausted. When this is noticed, the insoluble salts have got the upper hand to such an extent that it is not worth while to charge the same solution afresh with sal-ammoniac. The zinc should be thoroughly scraped, the old solution thrown out, and an entirely new sal-ammoniac solution prepared.

It seems right at this point to caution inspectors against the use in Leclanché batteries of common salt as an exciting solution. This material is so cheap and so accessible, that there is a constant temptation to use it, especially when one is examining a telephone at a residence or store, and no sal-ammoniac is at hand.

In addition to the fact that the electro-motive force of the elements is much less in a chloride of sodium solution than in a chloride of ammonium solution, it should be also noted that the salt has a much stronger tendency to effloresce and to creep over the sides of the containing vessel, making a very moist, unsightly, unpleasant body.

(*To be continued.*)

Accumulators vs. Transformers.

In the last number of the Western Electrician appeared an abstract of a paper by R. E. Crompton, on the superiority of the accumulator transformer system of electrical distribution, as compared with the alternating transformer system, which was read before the London Society of Telegraph Engineers and Electricians. The discussion was confined, for the most part, to Mr. Kapp. He said he was glad to know that reliable accumulators could be secured now. Mr. Crompton had said that 3,600 units per day was too much for a plant which could supply a maximum of 600 kilo-watts at the lamps. According to the London diagram it was so, but the Boston diagram showed 3,000 or even 3,600, and the Cincinnati diagram was not very far from that figure. The reason why the London diagram was smaller was that there were very few offices on, and probably not many theatres and public halls where the lights were on for many nights in the year. He agreed with Mr. Crompton that people had generally overlooked the fact that a conductor consisted of something more than copper. The cost of the insulation itself ought to be carefully calculated, but Mr. Crompton had put down a higher cost for insulation and laying than necessary. A high class lead covered cable of half-square inch section cost about 13s. per yard, and for the double conductor, £130 per 100 yards. Such a cable could be laid straight into the ground; the only protection necessary would be to cover it up with rough plank, and fill the trench. That would bring the cost up to a total of £155, and not £187.

Mr. Crompton interrupted the speaker to say that £187 had been paid.

Mr. Kapp said the insulation of a lead covered cable would be reckoned by hundreds of megohms per mile, while the insulation of Mr. Crompton's mains could hardly be 1,000 ohms per mile. A Berthoud-Borel cable of 155

square millimetres costs at the present advance in copper £40, or £80 for the double main, and £105 for the main laid. Mr. Crompton's main of only a slightly larger section cost £100. There then was a saving of 5 per cent., but was it worth while for so small a saving to give up a main the insulation of which was measured by megohms, and adopt one in which it was measured by hundreds of ohms only? Of course if Mr. Crompton's system was absolutely perfect it might be worth while, but he would not care to be the engineer in charge, and be responsible for the maintenance of these mains. He was opposed to the plan of having a network of high pressure mains throughout the whole district; he preferred a network of low pressu e mains, with only a few high pressure feeders going to stated points. In that way, instead of 20,000 yards of high pressure cable. there would be only a comparatively short system of such feeders, and along the network of distributing mains there would be a certain number of transformers—ten or twelve. Mr. Crompton took distributing mains of one-quarter square inch section, and fed them from four local batteries, which were to be installed in mews as near as possible to the line of lighting; but in that case there were either too few batteries or there was too small a section of main. It was evident that the fewer the points at which the network of mains was fed the larger must be the section to be able to take the currents without serious loss of potential. Mr. Crompton had mentioned four volts as the maximum variation allowable. That was too much. He doubted whether the British householder would put up with the same variations of light as he used to do with gas. The speaker thought something like two or three volts should not be exceeded. It was a very difficult matter to settle what size of main was necessary in a given district. It depended on the configuration of the place, because advantage must be taken of the carrying capacity through cross streets. To supply 10,000 lamps continuously burning nine or ten feeding centers would be required, and in Mr. Crompton's system advantage could not be taken of the interlacing of the network, as in a simple two-conductor service. To make up for the loss of carrying capacity of cross connections Mr. Crompton would have to use more local centers, and install at least ten battery stations if he wished to retain the quarter square inch mains and not exceed the variations of pressure. For such a number of centers six more attendents would be required, and at £100 a year each there would be an extra £600 working cost. If Mr. Crompton wished to retain the four battery centers, then, instead of a main of a one-quarter square inch he would have to use one of 1½ square inch. That would come to about £200 per hundred yards, so that the estimate have to be increased by £20,000. The maintenance would also have to be increased by £1,532, and it would probably be cheaper to subdivide the battery into ten local centers, and have more attendants. He wished to ask Mr. Crompton whether, in his estimate, he had included rent of room for accumulators. He had told them that he could not put a drain pipe through private property, but he wanted to put on private property a whole set of batteries containing sulphuric acid. The rent would cost at least £500 annually, and the wages of six additional men would raise the amount to £1,100 a year. But if the one-quarter square inch main were adopted, and the accumulators were fed by alternate transformers, ten in number, each capable of supplying a maximum of 1,000 or 1,200 lights, the rent would be insignificant, and nothing would have to be paid for attendance. Mr. Crompton said he was ready to supply batteries at the figures he had quoted, and he (Mr. Kapp) knew there were many people who would be willing to supply 10 transformers, each of 1,000 or 1,200 lights, for £3,000, as against the estimate of £7,500. The space occupied by each transformer would not exceed about 20 cubic feet, and it would not be very difficult to find accommodation for it in a chamber lined with cast iron under the footway, or in a small fireproof room on mews property. He was rather inclined to think the author had underestimated the cost of batteries. His authority for this statement was Mr Crompton himself. A few months ago he asked that gentleman what in his opinion would be the cost to be allowed for batteries which should have a very rapid discharge; and from the figures then supplied he found that the cost would be £30 per kilowatt, but according to the paper it would only be £15 to £16. Was there any maker who would supply a battery giving for a short time and without being injured 10 kilowatts at £160? Mr. Crompton's comparison of the two systems as regards efficiency was very unfavorable to the alternating transformers, assuming, as he did, that a transformer one-third loaded could not have more than 70 per cent. efficiency. That was merely an assumption, for Prof. Ayrton had given them the results of some experiments with a two horse power transformer which when working at 318 watts or a fifth of its full output, gave 80 per cent. efficiency, while at one-third of the full output the efficiency was 85.8 per cent. It was not necessary to work transformers at less than one-third of their output. If 20 per cent. loss were allowed in the feeding mains (which would be a very economical way of working) there would then be the 20 per cent. to draw upon when the transformers were working with smaller output, so that there was a tendency for the loss in one apparatus to be balanced by the gain in the other. If they worked with a reasonably large output it would not be found so bad as Mr. Crompton made out. He wished to ask a question about the regulation. When batteries were worked in private installations 2½ volts per cell were allowed for charging and 2 volts were obtained in discharging. How could Mr. Crompton insure constancy of potential whether he was charging or discharging? As far as the speaker knew, there two methods available. They could either couple the lighting circuit to the local centers through rheostats, which must continuously be adjusted in accordance with the demand—and this method, as they all knew, is in use in the Edison stations, but it, of course, entails a certain waste of energy—or they could charge the number of cells coupled between the lighting circuit, and thus they could regulate the pressure. But, in that case, some of the cells would get charged and discharged differently from the others, and he wanted to ask Mr. Crompton how he would protect those cells from injury under this treatment.

Mr. Parker did not take much exception to the figures which were given in the paper as to the cost of batteries. Though Mr. Crompton alluded to Vienna, he did not say what was done there. A matter of 400 or 500 volts did not appear to be a sufficient pressure to work the batteries with if a comparison was made with the other systems. The effort made some years ago at Colchester seemed to have fallen out of notice. The reason as to the failure of that installation did not seem to have been carefully studied. The first reason appeared to be the insufficiency to the number of lights attempted, and the second the mode of insulation used in the cells, which were not so good then as now. He would like to send some cells from Wolverhampton, to be tested against anything Mr. Crompton could find. He had just lately been able to carry out some improvements which would shortly be made public, and which would enable them to give much more life to accumulators, and to discharge at a more rapid rate. He did not think more had been done at Vienna than at private installations. The manipulation of a battery station was the difficulty, and he did not see that the cost stood in the way at all. The battery system could be carried out very much at the same cost as an alternate current system, and possibly might be perferable. Perhaps one of the most unique experiences was at Eastbourne, where the installation of alternate currents had been running for nearly two years, and there had been no accident or mishap, and the machine had run without any stoppage or ce-sation of light. He had mentioned these points, not with the view of throwing up any fire-works, but as Mr. Crompton had described what he had done he thought it was as well to state what others had done.

Further discussion of the paper was postponed.

The Luminously Bright Young Man.

[After Patience.]

By Henry Hine.

I

If you're anxious for to shine,
In the electric lighting line,
As a man of science bold,
You must run down torches flaring,
Lamps and gas and candles glaring,
And sneer at them as old.
You must crack up commutators,
Armatures and indicators,
Quantity, intensity and field of force,
Incandescence, insulation,
And magnetical rotation,
Which is soon to light the world, of course.

And every one will say,
As you walk your brilliant way,
If this young man is such a bright young man,
As to be too bright for me,
Why, what a very luminously bright young man,
This bright young man must be.

II

If you want to sell a plant,
You must get up all the rant,
You can crowd into your brain,
You must shoot it off your tongue,
To the people you're among,
Like a limited express train,
You must make all men believe,
That you never do deceive,
You'd rather burn your tongue off in the fire;
And this in spite of knowing,
While the words are from you flowing,
That you're a most outrageous liar.

And every one will say,
As you walk your brilliant way,
If this young man is such a bright young man,
As to be too bright for me,
Why what a very luminously bright young man,
This bright young man must be.

III

Your lamps for incandescence,
Are the concentrated essence
Of all that makes good light,
Your dynamos most efficient,
Your experts are omniscient,
Your joints all soldered tight.
The other fellow's stuff,
Is very crude and rough,
His arguments poor and lame,
Follow close these admonitions,
Steer clear of electricians,
And you'll get there all the same.

And every one will say,
As you walk your brilliant way,
If this young man is such a bright young man,
As to be too bright for me,
Why what a very luminously bright young man,
This bright young man must be.

Col. L. C. Baker, says in the St. Louis *Globe Democrat*, "It will cost the Western Union Telegraph company over $6,000 to put their wires in the Exposition building and get everything ready for handling the business of the democratic convention All our wires will be carried by cables, and we will have fifty operators to take care of bulletins, newspaper correspondence and the business messages of delegates. From this you can form an estimate of the number of words necessary to pay the company for its investment. Everything will be made especially for this meeting, and we expect to have the most perfect arrangements ever seen at any political gathering. Perhaps a better idea of the volume of business may be gathered from the fact that five counter clerks and fifty messengers will be required to receive the messages, which, after being checked, will be shot into the operating room through pneumatic tubes and thence sent out on direct wires to the principal cities of the country."

CORRESPONDENCE.

New York Notes.

New York, May 5.—An interesting suit is likely to grow out of the libel of the Inman and International Steamship company, limited, against the Western Union Telegraph company for damages to the steamship City of Richmond, caused by her screw becoming entangled in the submarine cables at the vessel's pier in Jersey City, August 19th, 1887. The Western Union company filed a cross libel on May 4th, in which it answers that the cables were properly laid and maintained, but that the officer in charge of the steamer carelessly ran her at low tide over the spot where the cables were submerged. Twelve of the cables were broken, and communication interrupted for 16 days to the great detriment of the business, and the cost of the repairs was $10,789. It is well known that the maritime interests have little respects for modern improvements, either railways, electric lights or cables, and this suit is of such importance financially that it will no doubt be fought through all the courts.

The capital stock of the Herzog Teleseme company has been increased from $250,000 to $500,000. The teleseme signaling apparatus has been approved by the police commissioners in preference to other devices entered in competition with it, but there is the usual amount of dissatisfaction expressed by the representatives of rival systems. President Herzog has submitted a modified contract in which he proposes to erect 400 lamp-post boxes below Forty-second street, larger than those he has already installed, with station house plants, etc., in complete working order for $100,000.

The recent deaths from electrical shocks, of Streiffer and Witte in this city, have had the natural effect of reviving the crusade against overhead wires. Since the organization of the famous Electrical Subway commission, no attempts appear to have been made by the arc lighting companies to renew their wires, on account of the uncertain condition of their future. The natural consequences has been that the lines have deteriorated and in many places are in a very dilapidated condition. The morning *World* has taken up the investigation of the existing condition of affairs, and organized a commission, composed of an electrician, a photographer, and a reporter. In two days they have devoted five columns to the subject with suitable illustrations, and as the circulation of the paper is national in extent, the general effect on electric lighting industries will no doubt be bad.

At the new Edison central station on Twenty-sixth street, two of the largest chimneys in the city are being erected. They will be 155 feet above the street level and measure 18′ 9″ x 10′ 2″ at the base and 15′ 9″ by 8′ at the top, the thickness tapering from 3′ to 1′ 4″. Each will be surmounted with an iron cap weighing one ton.

The secretary of the Russian legation visited Pittsburgh on May 1st, where he is said to have concluded an important contract with Mr. Westinghouse for the use of a filament for incandescent lamps invented by one of his countrymen. The particulars regarding it are not generally known at present, but it is said to be far superior to anything of the kind now in use.

At the meeting of the executive committee of the National Electric Light association held in this city yesterday, it was decided to hold the next convention at the Hotel Brunswick in this city, August 29th, 30th and 31st.

The annual meeting of the American Institute of Electrical Engineers, for the election of officers, will be held at 127 East 23d Street, on May 15th. The general meeting for the presentation of papers and their discussion, will convene at 10 A. M. on the following day. The following papers will be read: "A new system of alternate current motors and transformers," by Nickola Tesla; "On compensated resistance standards," and "On Professor Moler's swinging arm galvanometer," by Prof. Edward L. Nichols, of Cornell university; "The possibilities and limitations of chemical generators of electricity," by Francis B. Crocker; "Subterranean electrical system," by Professor George W. Plympton; also a paper descriptive of a new electrical meter, by Professor Geyer, of Stevens Institute.

A new electrical journal has been born and christened *The Electric Items*. It is to be published semi-weekly, and as its name implies is to furnish electrical items while they are fresh, for the obvious benefit of the electrical trade.

Walter P. Phillips, an old telegrapher and journalist and the successful general manager of the United Press, has bought an interest in the *Electric Age*, established by J. B. Taltavall, and of which Mr. Phillips will be the editor. It is the intention of the proprietors to give greater attention hereafter to the general electrical field.

The publishing office of the *Electrical Engineer* has been

removed from 115 Nassau to 11 Wall street, where the editorial rooms have been located for three years past.

A fire broke out about 11 o'clock one night last week, in the chemical laboratory on the top floor of the west wing of Stevens Institute of Technology in Hoboken. It is supposed to have been caused by spontaneous combustion, and was well under way when the firemen arrived. In about two hours the flames were subdued, the damage from fire and water being about $5,000. P.

Minneapolis Mention.

MINNEAPOLIS, May 5.—The Minneapolis Electric club, or Society of Electricians was organized on the 24th of February, 1888. The purpose of the club is the study of theoretical and applied electricity and to demonstrate every subject by means of experimental and laboratory apparatus. The officers elected are as follows: Geo. W. McDonald, president; Vernon Bell, vice-president, and chairman of the entertainment committee; Robert T. Reid, chief operator Western Union, J. W. Phinney, of the American district telegraph, N. J. Mershon, superintendent Minnesota Brush Electric company, vice-presidents; Wm. C. Thompson of the Minneapolis Electric Construction company, treasurer; Samuel A. Sims, secretary. The entertainment committee consist of Russell S. Bates of the Electric railroad; A. H. Gibbon, electrician Washburn Mills; S. S. Leonard, general manager Minnesota Brush Electric company, and W. F. Smith, electric light engineer. The club have at present $250 worth of instruments and apparatus. Up to date there has been about $2,000 subscribed which will ultimately be applied to the purchase of a complete outfit of demonstrative electrical appliances. The club is particularly fortunate in having Professor E. R. Sheppard to lead them in their experiments.

The Minneapolis Electric company report business in a very good condition. Through the courtesy of Jason Hidden, manager of the supply department, your correspondent looked through their store and warehouse and was surprised to find so large and complete a stock of all kinds of electrical goods necessary for an extensive business. This house is sole agent for the Okonite company, also for the American Watchman's time detector. Wm. C. Thompson, superintendent of construction of this company, reports business on a very firm footing. The work of importance that they have in progress just now is the wiring for and the putting in of all the modern appliances in the electrical line, bells, annunciators, gas lighting, etc., in all the better insulations of the kind in Minneapolis. They are installing a system in the residence of B.S. Bull, which will be the most complete system in any house in the Northwest; it consists of bells burglar alarms, annunciators, gas lighting, etc. The burglar alarm and gas lighting apparatus are so arranged that when an entrance is made in the house one or all of the lights will be lighted. They have just completed a system of speaking tubes and bells in the wholesale grocery house of Geo. R. Newell & Co., and are about perfecting a system of fire alarm in connection with the city department which they claim will be positive in its action, give no false alarms and be perfect in results. They make a specialty of electric gas lighting in churches, theaters, etc., and the kind of work they do in this line may be seen at the People's theater, First Congregational church, First Baptist church, Hennepin Avenue Methodist church and Masonic Hall. Vernon Bell, electrical engineer, has been a resident of Minneapolis since 1866. Mr. Bell is agent for the Spang radial system of lightning conductors, which takes much of his time, but at present he has a contract for fitting up three fine house in Minneapolis with bells, and annunciators, etc. H.

From the Pacific Coast.

SAN FRANCISCO, April 30.—The wires of the Gold and Stock Telegraph company and the American District Telegraph company were crossed April 23d, and several switchboards were burned out.

R. D. Valentine, the new electrical engineer of the Thomson-Houston company, in this city, reached here last week. He formerly had charge of the Thomson-Houston plant at Clinton, Ia.

The California Electric Light company have moved to 227 and 229 Stevenson st. The building is connected with their works on Jessie st.

The boiler in the office of the *Morning Times*, at Oakland, exploded April 23d. No one was injured. Within four hours a ten horse power motor was installed to run the press. The *Tribune* took time by the forelock and secured a twelve horse-power motor. The motors were installed by the Oakland Light and Motor company.

The electric light plant at Santa Ana is now in operation.

The Stolton Electric Light and Gas company, operating the Fort Wayne Jenney system, have bought the city contract of the Indianapolis Jenney company, at Sacramento, and have also purchased the plant of the latter company which is building.

C. S. Scholes has been appointed superintendent of telegraph of the Chicago, Santa Fé & California railroad. C. L. Nichols has received appointment as superintendent of telegraph for the Kansas City division of the same line.

Merced is to have an electric street railroad.

A telegraph line is being built from Point Reyes by the local signal service officers, to connect with the office of Lieut. Maxwell, in the Western Union building. The line will be 40 miles in length and will cost $5,000.

All the ferry boats of the C. P. R. R. Co. and S. P. R. R. Co., will be lighted by incandescent lamps. S.

St. Paul News.

ST. PAUL, Minn., May 5. — John H. Reid, of Mather county, spent a few days of the past week in this city. Mr. Reid has recently returned from a three months' visit to California, and while there enjoyed great sport.

Mr. Russell Baker, formerly superintendent of the gas company's electric light station, is now in charge of the Economy Steam Heat company's lighting station with the United States company's incandescent and the Western Electric company's arc system. Mr. Baker says he is going to make things lively for the other boys.

The Barnum Electro-Plating works established by C. D. Barnum in Minneapolis in 1883, commenced upon a small scale, and have gradually added to their plant as the demand for first-class work in the plating line has increased in the northwest. Their plant now consists of one large Weston dynamo which runs their 200 gallon nickel tank, 100 gallon silver tank, and brass, copper, bronze, and other plating solutions. Their buffing room is complete in every respect. They are furnished with all the necessary apparatus to do first-class plating in all its branches. Owing to the increase in manufacturing industries in St. Paul they were induced to establish a branch shop in the city of St. Paul. They also have here a complete outfit under the management of A. W. Noble, who has recently purchased a controlling interest in the business. The Barnum Electro-Plating Works, managed by so energetic a young man as Mr. Noble, cannot but prosper.

John E. Dempsey, electric power printer, states that there is no other power to be compared to electricity for running printing presses, as regards economy, cleanliness, and easy management.

The Northwestern Telephone Exchange company report business as very good. The local management has recently changed hands. P. Yensen having resigned a short time since, W. B. Joice, who has for some time past been local manager at Minneapolis, has been promoted to that position at St. Paul. Mr. Joice, while at Minneapolis, was secretary of the Minneapolis Electric club and had made many friends among the electrical fraternity. The St. Paul Exchange at present has about 1,200 subscribers, employs 40 young ladies, and answers about 10,000 calls daily. Mr. Joice states that they have about 1,000 lines out at the present time, and they expect to extend their lines to a considerable extent the coming summer. Mr. Yensen, formerly the local manager, has started for California, but what his future intentions are is unknown to the writer. The St. Paul exchange has the reputation of being one of the most efficient and prompt in the country and, under the management of Mr. Joice, the high standard of excellence will certainly be maintained. W.

From Kansas City, Mo.

KANSAS CITY, Mo. May 5. — The installation of the electric light plant for the Metropolitan Cable company, to be used for lighting their viaduct, curves and crossings, was finished and started on Saturday, April 28th, and for neatness of construction is second to none throughout the west and adds greatly to the lighting facilities of our city. It will also add to the safety, comfort and convenience of the patrons of the Cable company. The system used is the Fort Wayne Jenney; capacity 20 lights of 3,000 candle power each. The installation was under the direct supervision of the company's expert, C. Kammeyer. The lights are swung from the celebrated O'Beirne patent mast arms. Five lights are used on the viaduct which is 1,000 in length, the remainder of the lights being distributed on the various curves and crossings.

A. M. Barron has been appointed by the Home Telegraph company of this city superintendent to succeed George Hewes, who lately resigned. The former assumed his duties May 3d. D.

Indianapolis Items.

INDIANAPOLIS, May 5. — The Jenney Electric company, of this city have contracted with Oliver Finney & Co. of Memphis, Tenn, to furnish an electric light plant for their extensive warehouses and are wiring the building.

A large number of applications have been received by the city clerk for specifications for lighting the city by electricity and several bids have already been received. Bids will be received up to 8 o'clock, Monday evening, next, at which time they will be opened in council and possibly a decision made.

The Crawfordsville, Indiana, council has entered into a contract for seventy electric lights, of 1,200 candle power each, for three years, and for which the sum of $5,000 a year is to be paid, the lights to be in running order by August 15th. The Thomson-Houston system is to be used.

The Consumers Gas Trust company has contracted with the Central Union Telephone company for the building of a telephone line along their route from Noblesville to this city. M.

From Cincinnati, O.

CINCINNATI, O., May 5.—The buildings of the Centennial exposition of the Ohio Valley to be held in this city are to be lighted by an exhibition plant, the apparatus being furnished by the manufacturers and operated by the exposition. The plant consists of the following: Two 300 horse power Galloway boilers; one 200 horse power Buckeye engine; one 125 horse power Buckeye engine; one 200 horse power Atlas engine; one 125 horse power Russell engine; seven 30-light Western Electric arc dynamos and 175 lamps; seven 30-light Waterhouse arc dynamos and 175 lamps; two 500-light Mather dynamos and 1,000 lamps; two 500-light Edison dynamos and 1,000 lamps.

All of this apparatus will form a combined exhibition and service plant, and will be under the control of the commission. The whole is to be in operation by June 15th, and the exposition will open on July 4th, and continue 100 days.

The commission have a guarantee fund of $1,000.000 behind them.

Partial arrangements have been made for an additional plant which will probably consist of a 100 horse power Ball engine and two 500-light dynamos furnished by the Queen City Electric company of Cincinnati, the plant being placed in a separate building from the other and for a special purpose. G.

THE ELECTRIC LIGHT.

The Thomson-Houston company, of Chicago, will install a 30 light arc plant at Mankato, Minn.

The Thomson-Houston company, of Chicago, will install a small incandescent plant at Los Angeles.

The Silvey Electric company of Lima, O., has secured a contract for installing a $10,000 plant at Minerva, O.

The Home Electric Light, Heat and Power company, of Dennison, O., has been incorporated; capital stock $25,000.

The Western Engineering and Electrical company, of Chetopa, Kan., has been incorporated by E. W. Clark and others.

The Westinghouse incandescent system has been adopted by the authorities of Richfield Springs, N. Y., for street lighting.

At Trinidad, Col., two dynamos, each of thirty-five arc light power, will be installed by the local electric light company.

The Madison (Wis.) Electric Light company has purchased a 30 light arc plant of the Thomson-Houston company, of Chicago.

The combined electric light installations at the Glasgow International exhibition number 559 arc lamps and 750 incandescent lights.

The new carbon works in Carondelet, Mo., are said to be turning out 20,000 points per day in addition to the regular line of specialties.

Prince Bismarck's prosperous paper mill at Varzin is lighted throughout by electric light. The prince is a great admirer of the system.

The city council of Mt. Vernon, O., recently passed a resolution stating that it was expedient for the city to substitute electric light for gas and gasoline.

The Fremont, Ohio, Electric Light company has decided to increase its plant by purchasing 70 arc lamps of the Thomson-Houston company, of Chicago.

The Allegheny County Light company, of Pittsburgh, has has now 15,000 sixteen candle power incandescent lamps in operation and is continually increasing the number.

The Lawrence Gas, Coal and Coke company, of Lawrence, Kan., has increased its electric plant by purchasing 70 arc lights of the Thomson-Houston company of Chicago.

Clarksburg, W. Va., has contracted for lighting the town with electric lights of 800 candle power, moon schedule, for $1,380 a year. The plant is to be in operation within two months.

The New York *World* has declared war on the overhead wires in the metropolis. It publishes a cartoon representing citizens adorned in insulated suits as a protection against electric currents.

The Hawkeye Electric company, of Oskaloosa, Ia., will install an incandescent plant at Montezuma, Ia. The same company will furnish the necessary apparatus for increasing the capacity of the Storm Lake Electric plant to 600 lights.

The plan for burying the electric wires, proposed by the commissioners of the District of Columbia, includes the placing underground of 2,671,000 feet of wire at a cost of $180,000. The total length of wire now in the District service is 2,851,200 feet, of which 132,000 only are underground.

The Thomson-Houston company, of Chicago, intends to fit up an exhibition plant in its new building on Michigan avenue. The arc and incandescent lights will be shown, and intending purchasers will be given an opportunity of inspecting the operation of the motors. All the machines in the room will be operated by electric motors.

The Northern New York Electric Lighting Station, Thomson-Houston system, 134th street and Lincoln avenue, New York, is now running nearly 100 lights both in street and private lighting. This company has in contemplation the erection of a new building on Rider avenue and 138th street. It is expected that the ground will be broken in a few weeks.

Dr. Shilling at a recent meeting of the German association of Gas and Water Engineers in a report said that while electric light had been adopted in Germany outside of the circles of distribution supplied by the gas companies, it must be admitted that it had also made notable progress in several cities supplied with gas. In thirty large towns, the number of establishments lighted by electricity had augmented in the course of the two last years from 138 to 604; the number of arc lamps from 591 to 3,280, and that of incandescent lamps from 10,403 to 50,469—amounting to about 4 per cent. of the number of gas burners in the same towns.

The apparatus constructed by Ganz & Co., of Buda-Pesth, to facilitate the movement of troops by railway transit during the night has been found very serviceable. It comprises a transportable steam engine of eight horse power, in the rear of which is located an alternating current dynamo capable of working eight 600 candle power arc lamps. A wagon carries, in addition to the lamps and their supports, the posts which are to carry the line, wire coiled on a drum which is mounted upon a carriage, the necessary tools, and two water tanks, for the supply of the engine. Both the engine and the van are constructed to be readily transferred to railway platform wagons, and thus transported by rail. On arrival at a given railway station, some of the workmen erect the posts and locate the lamps at the points indicated to them, while the engineer is getting up steam. Less than seven hours suffice for the installation, by eight workmen, a fitter, and an engineer; while the whole apparatus can be dismounted within five hours. The cost of the lighting for the eight arc lamps, during ten hours, was 17.5fr.; the whole apparatus costing about 21,000fr.

The Lotus club building in New York, had a narrow escape from fire last week. It has more than one hundred incandescent lamps in its house, 147 Fifth avenue, which are supplied by an arc light circuit. Some of the wires run under the floor of the dining room and above the ceiling of the library. About 7 o'clock the incandescent lights went out and gas was used. Twenty minutes later a fire was found making headway between the library ceiling and dining room floor. The damage was limited to the breaking of the floor and ceiling in the dining room and library, and the spoiling of the frescoes and the wall papers. Another dispatch from New York says: A poorly and carelessly insulated electric light wire caused another fire at 749 Broadway. The fire originated in the ceiling above the second floor occupied by the *American Magazine*. Three or four beams were burnt nearly through before the fire was discovered. Three weeks ago the telephone in the office was burned out by its wire coming in contact with a poorly strung electric light wire. A new telephone was put in and the same thing happened again. The damage was chiefly caused by water.

For two days last week in New York a coroner's jury investigated the case of Meyer Streiffer, the lad who was instantly killed by a shock from an electric light wire April 15th. George Farrell, chief operator of the fire department, testified that in wet weather the insulation on electric light wires was affected, as when the wires were wet a current might be transmitted through the covering. He knew from experience that a person might get a terrific shock from coming in contact with a broken wire lying across an electric light wire, and he thought a shock sufficient to kill might be so sustained. He would not willingly allow a current of 200 volts to pass through his body. Dr. Otto A. Moses, the electrical expert, said a shock from a current feeding twenty-one arc lights of 2,000 candle power would be sufficient to cause death, as forty volts would be required for each lamp. He explained the difference in potential by various ways of connecting the wires, and said they would be less dangerous if put in multiple arc; but that would necessitate considerable expense in changing from the series system, as practically a separate wire would be required for each lamp. Under certain conditions an electric light current could be deflected to another wire and a person might be killed by coming in contact with that wire. He said if the wire had not been dangerous the boy would not have been killed. In brief, Dr. Moses said the over head electric light wires were a "perpetual menace to human health and constant danger to human life," but he did not see how it could be avoided. "In Europe," said the witness, "the overhead electric light wires would not be tolerated one instant." He said in London they were under ground, but that system hindered the development of electrical interests. In case of a general breakage of wires at a fire Dr. Moses said there would be much danger. The danger, however, is from small wires, as electric light currents being powerful enough to burn up the smaller wires can "look out for themselves." After being out an hour and a half the jury found that the boy came to his death by the electrical shock from a wire in contact with one of the wires of the United States Illuminating company, and concluded: We also find that the death of the said Meyer Streiffer is due to the neglect of the United States Illuminating company in not removing the said loose wire which was shown to have been hanging there for more than four weeks, thereby endangering health and life of the public. We would respectfully call the attention of the city authorities to the great danger and standing menace to health and life for allowing electric wires to be exposed above ground, and therefore recommend that immediate steps be taken to guard against an occurrence of such nature in future.

THE ELECTRIC MOTOR.

It is said that Mr. Yerkes of the Chicago North side and West side street railroads has been making numberless experiments lately with newly patented motors of all kinds, and has also been closely studying the subject of electricity with a view of its introduction as a motor on his West side cars. As the consciousness of failure on the North side, and elevated road agitation on the West side becomes stronger, the prospects of the Philadelphia syndicate cabling the West side grows weaker.

A company which will ask a franchise of the Milwaukee, Wis., city council, proposes to build a road running east and west on North street, thus tapping or acting as a feeder for six other street railways that run north and south. The new road will be one and one-half miles long and will be operated by electricity. The parties forming this company are prominent residents of Milwaukee. It is also proposed to extend the line so that it will connect with the new dummy line and possibly to Wauwatosa.

Apparently the objection remains against the electric motor that it costs a little more than horse power. Experience only can determine whether it is eventually more costly. If so, it is very unlikely that the additional cost will be large enough to make electric cars unprofitable. They have been introduced into twenty-one cities in this country, and we have as yet to hear that in a single instance the expense of the electric motors has prevented the traffic of any of the lines using them from being lucrative. Other things being equal, the public will always ride in electric cars in preference to horse cars.—New York *Herald*.

In the Sprague electric railway in Richmond, Va., using an overhead conductor, it is costing for power about $1.70 per day for each car—the average run being over eighty miles. This is for only twenty cars, and when the full complement of cars is put on the cost will probably be reduced to about $1.50 a car a day. This power replaces horses which cost between $5 and $6 a day for each car when the average trip was only sixty miles a day. If the overhead system could be used in Chicago there would seem no reason for the cumbrous and expensive cable system. And if not the overhead, then some other form of electric motor should be employed.

In speaking of electric motors the *Progressive Age* says: "Here in New York a car can be seen in operation on the Madison avenue line, and the results obtained have been so satisfactory that the company only wait the permission of the city to substitute this system for that of horses. These are but illustrations of the interest that is being awakened throughout the country and may be taken as indications that this means of street car propulsion is destined to soon largely take the place of horses or cables in the large cities and towns; it is not likely that cable lines now built will be changed, but once the utility of electricity is throughly demonstrated the chances are that not many more cable lines would be built."

THE TELEPHONE.

The telephone service on the Chicago river is to be extended to Eighteenth Street. Lookouts are to be stationed at the north pier to notify the vessel dispatcher of the approach of boats.

The telephone contest has been reopened says a Washington dispatch, although the public thought it at an end when, a few months ago, the Supreme court decided in favor of Bell. Drawbaugh people are now more enthusiastic than ever. There is Senator Edmunds and Postmaster-general Dickinson, the Washington counsel in the Drawbaugh case, have this week been in consultation with the New York and Boston counsel of the Drawbaugh syndicate to complete their final plans for the filing of a petition to reopen the Drawbaugh case. The telephone case will soon be an issue before the Supreme court.

One has to go to other cities in order to thoroughly appreciate the revolution brought about by the use of the telephone. In small cities like Cleveland and Detroit, all the well to-do people have telephones in their dwellings, and the useful instruments are made to serve instead of letters, visits, and the employment of messengers. The ladies use them quite as much in the routine of household life as our down-town men do in business. After breakfast in the morning a provincial lady who has a telephone is apt to closet herself with it for a half an hour or more, during which time she finds out what the grocer has that is good to offer, sends her orders, connects with the butcher, and tells him what she wants; rings up her dressmaker and has a delightful chat over trimmings and flounces, and then calls upon one after another in her circle of lady friends, and gossips with each and all precisely as she would if she were making a social round in her carriage later in the day. The average New Yorker has scarcely any conception of the usefulness of a telephone as it is employed in other cities.—New York *Sun*.

A dispatch from Montreal says: Some time ago an opposition company to the Bell Telephone was started under the title of the Federal Telephone company, with the professed object of breaking the Bell monopoly in this city. Somehow the public got an idea it was solely a scheme to force the Bell people to buy out the new company's charter. Some of the wealthiest men in town went into the concern, and at last the necessary formalities were complied with and permission to lay poles was granted by the city council, the matter being put in the hands of the city attorney to draw up in legal form. The papers were presented to the acting mayor for his signature, but that gentleman refused to sign it. Then there was a great row in the council, and some of the aldermen were particularly anxious to have the matter settled at once. Acting mayor Cunningham, however, refused. An injunction will be taken out to prevent the final passing of the law permitting the erection of poles, etc. The document sets forth various causes, but the most startling is one that charges Alderman Jacques Grenier with being an officer of the Federal company and at the same time voting in favor of passing the contract. Such a course is forbidden. Alderman Laurent and Mayor Abbott are also large holders in the new company, but the mayor has never taken any part in the telephone question.

THE TELEGRAPH.

A ten-foot section of the cornice of a building on North Clark street, Chicago, fell without warning last week. Fortunately it caught in the telegraph wires, and only fragments struck the passers-by.

General Greely has contracted for the laying of a new cable from Woods Holl, Mass., via the Pasque and Naushon Islands to the Vineyard Haven, Martha's Vineyard, It is to be in working order by July 15th.

In the United States circuit court last week in New York, Judge Wallace issued an order for an injunction restraining the Bankers and Merchants' Telegraph company from removing the wires of the American Rapid Telegraph company strung upon the poles of the former between Albany and Portchester until $25,000 forfeit has been posted.

"There are plenty of good telegraphers being turned out now just as there have always been," said a veteran telegrapher to a Chicago *Herald* reporter, "but the introduction of multiplex systems has had a bad effect on the business, in regard to the individual speed attainable, and the constant reduction in salaries has removed much of the inducement to become thoroughly proficient. Still, if a boy has it in him—for you must know that good telegraphers are like poets, they are born, not made—he can become an expert as in the old times."

The new contract between the Chicago, Milwaukee and St. Paul railroad and the Western Union Telegraph company went into effect May 1. By its terms the Western Union company assumes control of about 1,900 miles of telegraph wire heretofore operated by the railroad company. This includes over two hundred offices in Iowa, Nebraska, Minnesota, and Dakota, located on the Kansas City, Chicago and Council Bluffs, Sioux City and Dakota, Jim River, Hastings and Dakota, and Chippewa Valley and Superior divisions of the Chicago, Milwaukee and St. Paul road. The telegraph lines in question pass through territory in which the railroad was built within the past five years. The new contract, it is said, will be a good thing for the farmers and dealers in and receivers of grain, as the expense of telegraphing will be cut down about half. The contract is made for a term of years. The Western Union now operates the entire 5,000 miles of telegraph contiguous to the railroad tracks of the St. Paul system. The reason that the expense of sending a message to these points is reduced under the new contract is that a single check only is necessary to send a message, while under the old system a double check was required.

Dr. Norvin Green, president of the Western Union Telegraph company was before the house committee on post-offices last week, and gave his views on the Hopkins bill to establish a postal telegraph. The action contemplated in the bill, he said, would be unjust to existing companies unless it provided for their purchase at a fair valuation, as provided by the act of 1866, "to aid in the construction and maintenance of telegraphs." It would be a gross outrage to subject private capital to government competition, when any deficit in the latter would be made good out of the general treasury. Dr. Green professed not to fear competition on even terms, believing that the more prompt service of the corporation would insure it the bulk of the business, in which promptness was of far greater account than economy in rates. Dr. Green was particularly bitter in his reference to the drag-net subpœnas, which had compelled the production of great files of messages. He referred to the action of United States senate committee investigating the Hayes-Tilden election and declared that he hoped never to live to see such another outrage. He thought that Congress should pass a law upon the subject.

Miscellaneous Notes.

A fire in Stevens' institute at Hoboken, N. J., last week damaged the laboratory apparatus to the extent of $5,000.

The Inter-Ocean Electric company of Chicago has been incorporated with a capital of $100,000. The incorporators are Samuel D. Snow, John E. Cooper and Edward Maher.

The Edison Phonograph manufacturing company has been incorporated with a paid up capital of $300,000. The incorporators are Thomas A. Edison, Alfred O. Tate, Charles Batchelor and John C. Tomlinson, of New York.

Lightning distributed its favors by the wholesale at Woodsville, N. H., last week. The farm buildings of George O. Butler were struck by lightning and burned, together with 16 cows, 2 horses, 18 hogs, and 3 young cattle. The loss is about $4,000; nearly covered by insurance.

One of the most ingenious inventions of the day is the self-registering thermometer which a London firm has just announced. It consists of an indicator which can be set up in any greenhouse. When the temperature falls below the point at which injury would be caused to plants an electric bell is set in motion so that the alarm is at once given.

Bill Nye, in closing an alleged humorous article on electricity, said: "The time is coming when even greater wonders will be worked, and with electric wires, the rapid

transit trains and the English sparrows under the ground, the dawn of a better and brighter day will be ushered in. The car driver and truckman shall lie down together, Boston will not rise up against London, he that heretofore slag shall go forth no more for to slug, and men shall learn scrapping no more."

C. W. Dean delivered a lecture last Sunday in the Church of Nature in Chicago on the subject, "The World; What it is; What it is Made of; How it was Made and What for": Primarily he dealt with the all important part played by the forces of electricity in the creation and maintenance of life in all matter. A review of the place of electricity in nature absorbed a very considerable portion of the time allotted for the lecture, but the lecturer held that this force of electricity was the vital fact at the root of the whole scheme of life whether vegetable, animal or human. The lecturer held that through electric forces first came vegetable or plant life, and this primarily was the coral.

Personal Paragraphs.

W. O. Scott has resigned his position as salesman of the Electrical Supply company and has accepted a similar position in the electrical department of the New Haven Clock company, 315–321 Wabash avenue, Chicago.

At a meeting of the Chicago Gas Trust directors last week, C. N. Fay, formerly general manager of the Chicago Telephone company was elected president, an office which he has filled since his retirement from the telephone company.

H. B. Cox, formerly of Cincinnati, O., now of New Haven, Conn., will sail for Berlin, May 19th, to dispose of his foreign patents, having received some flattering offers from business men of that city. He also has received offers from Barcelona, Spain.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	400
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	70	72

Business Mention.

Sebastian, May & Co., of Cincinnati, Ohio, have just issued a new catalogue of lathes, tools and supplies which is the most complete they have ever sent out. They will take pleasure in mailing a copy to any one interested, upon receipt of the address.

The New Haven Clock company have recently issued a handsomely illustrated catalogue pertaining to their electrical department. A number of the illustrations appear in colors. Several new and interesting electrical devices are shown. The Chicago office is at 321 Wabash avenue.

The contract for making the woodwork of the Edison phonograph and the Edison mimeograph was closed a few days since with the Gilliland Electric company, Adrian, Mich. It is a very large one, and necessitated for its rapid execution the very latest improved machinery which could not be found elsewhere than in the shops of the Egan company, of Cincinnati, whose woodworking tools are recognized as a standard of excellence the world over. The long looked for and much talked of "talking machine" will soon be placed on the market.

The Thomson-Houston company moved into new quarters, 148 Michigan ave., between Adams and Monroe streets, last Saturday. The new building, of which the company occupies the basement, first and second floors, is admirably adapted for the purpose. The offices are handsomely furnished and carpeted. The private offices are partitioned off from the main room, and they are models of neatness and convenience. The company is now in a better position than ever to transact its growing business.

It will be noticed by reference to their advertisement Charles A. Schieren & Co., of New York, have opened a branch office of 46 South Canal street, Chicago. Emil Gabel, formerly president of the Gabel Belting company of Chicago, will be in charge. A large stock of standard and extra grades of belting and also "electric" belting will be kept on hand. The American Leather Link Belt company being under the control of Schieren & Co., will also have their Chicago office at 46 South Canal street and it will be under the control and management of Mr. Gabel.

The Pond Engineering company, of St. Louis, never undertake a job that they do not carry to a successful completion. This remark is particularly to the point in reference to their 1888 catalogue entitled, "Steam and Hydraulic Machinery." Typographically, the book is tasteful, while between the leaves of its artistic cover is found a mass of useful knowledge relating to mechanical engineering of great value to the electrical constructing engineer. The catalogue will be sent to any address upon application.

Wire of the New York Insulated Wire company's make is in use at the capitol in Washington, Thomson-Houston system; navy building at the same place, Edison system; Philadelphia postoffice, United States system; Levi P. Morton's house at Rhinecliff, Sawyer-Man system, and extensively in Philadelphia; Baltimore and Boston by the Edison company. The principal properties of the insulation of the wire are that it has very little contraction and expansion, does not harden by exposure to cold or soften by heat. The white core of the insulation is an unvulcanizing substance. So much faith was had in the good properties of this insulation that the wires for the Consolidated Stock and Mining Exchange in New York were imbedded in the wet plaster.

The rapid advance of electric lighting as the safest and most perfect system of artificial illumination for manufacturing establishments, has received another illustration in its adoption by the famous and successful American Waltham Watch company, whose delicate work requires the best possible light. This corporation, which has always maintained its reputation for sagacity and enterprise by adopting the latest and most improved methods of manufacturing, after careful examination, has decided to introduce the incandescent light throughout the entire establishment. Some idea of the extent of this manufactory may be gained when it is stated that it will take between four and five thousand lights to illuminate it, and the electrical plant, when completed, will be one of the largest private plants in the country, and considerably more extensive than the total system of many a city. It has often been asked why the company has not introduced electric lights before, but new discoveries have been made and improvements added so rapidly during the past few years, that the company have thought it best to wait until they were sure which of the numerous systems was suitably adapted to their work. The system finally selected is that of the Mather Electric company, of Manchester, Conn.—*Waltham, Mass., Free Press.*

Electrical Patents.

Issued May 1, 1888.

381,907. Pneumatic Railway and Conveyer. Thomas A. Connolly and Anthony A. Connolly, Washington, D. C.

381,915. Electric Lighting Apparatus for Railroad Cars. Harry E. Dey, New York, N. Y.

381,938. System of Telephonic Intercommunication. John A. McCoy, Medford, Mass.

"Claim 1. The hereinbefore described improvement in connecting apparatus for automatic telephone exchanges, comprising a series of disks, one for each line, carried upon a single rotating shaft, a series of rotating arms normally engaged by the said disks and rotating therewith, each of the said arms constituting the terminal of a telephone line, a series of lifting rods, one for each line and connected by branch circuit with said line, disposed around the central shaft and provided with projecting arms equal in number to to the number of disks, and a single electro magnet controlling each of the said lifting rods and adapted, when energized, to move the said rod longitudinally, whereby the rotating line terminal at the time opposite anyone of the projecting arms of the said rod may be engaged, lifted from its disk engagement, and electrically connected with the line represented by said lifting rod."

381,941. Secondary Battery. Abraham V. Meserole, New York, N. Y.

381,953. Electric Pen Holder. Charles W. Reiter, Denver, Col.

381,968. Electro Magnetic Motor. Nikola Tesla, New York, N. Y.

"Claim 1. The combination, with a motor containing separate or independent circuits on the armature or field magnet, or both, of an alternating current generator containing induced circuits connected independently to corresponding circuits in the motor, whereby a rotation of the generator produces a progressive shifting of the poles of the motor."

381,969. Electro Magnetic Motor. Nikola Tesla, New York, N. Y.

"Claim. The combination, with a motor having independent energizing or armature circuits, of an alternating current generator with corresponding induced circuits connected with the motor for effecting a progressive shifting of the poles of the motor armature, and a source of continuous current for energizing the field of said motor."

381,970. System of Electrical Distribution. Nikola Tesla, New York, N. Y.

"Claim 1. The combination, with a core closed upon itself, inducing or primary coils wound thereon and connected up in independent pairs or sets, and induced or secondary coils wound upon or near the primary coils, of a generator of alternating currents and independent connections to the primary coils, whereby by the operation of the generator a progressive shifting of the poles of the core is effected as set forth."

381 992. Watchman's Time Detector. George B. Fessenden, Boston, Mass.

381,993. Watchman's Time Detector. George B. Fessenden, Boston, Mass.

382,001. Electric Gas Lighter. Charles W. Holtzer, Brookline, Mass.

382,098. Apparatus for Preparing Secondary Battery Plates. Albert F. Madden, Newark, N. J.

382,110. Protector for Electric Lamp Sockets. Christopher P. Reilly, New York.

382,112. Automatic Switch for Secondary Batteries. John S. Sellon, Hatton Gardens, County of Middlesex, England.

382,165. Automatic Temperature Regulator. Warren S. Johnson, Milwaukee, Wis.

382,174. Armature for Dynamo Electric Machines. Robb Mackie, Troy, N. Y.

We give claims 1 and 4: "1. A disk armature having its coils wound in the plane of rotation, the cores of which coils are composed of iron plates arranged in substantially radial lines, as shown, whereby the magnetic density is greatest at the part of the core nearest the axis of the armature.

"4. In an armature for dynamo electric machines or electric motors, the core or body built up of iron plates circumferentially discontinuous, insulated from each other, and formed with projections in the plane of the shaft adapted to receive coils of wire or a conductor."

382,183. Apparatus for Producing Metals by means of Electrolysis. Johannes Ombholt, Gossnitz, Saxe-Altenburg, Germany.

382,195. Telegraph Receiver. Charles Selden, Baltimore, Md.

Use is made of a tuning fork, preferably one that is permanently magnetized, which is operated electrically by means of a magnet or other device, connected in the main line, to produce vibrations at the ends of the tines of the fork.

The first and last claims are: "1. In a tone or harmonic telegraph, the combination, with a tuning fork operated by the main current, of an independent set of contacts in a local circuit, a support for the contacts and adjusting devices for said support.

"6. In a tone or harmonic telegraph, the combination, with a tuning fork having a certain rate of vibration and controlled by the main line currents, of an independent set of contact devices controlling the local receiving instruments and adjusting devices, whereby the contacts may be arranged so as to be operated only when the fork vibrates normally."

382,231. Electric Igniting Apparatus. Leon Hen and Rudolph Weinmann, Brussels, Belgium.

382,249. Automatic Electric Gas Burner. Elmer E. Bailey, West Everett, Mass.

382,253. Fire Alarm Signal Circuit. William Carroll, Chicago, Ill.

The object of the invention is to prevent a failure of signals in case the watchman should fall asleep, or for any other reason fail to discharge his duty. The invention consists in the circuits and switching apparatus at an engine house, so arranged that the signal from the first line may be received at night without disturbing the men or unhitching the horses, while the signal over the second line will operate the door opener and sound the alarm, unless the attendant shall, between the time of the first signal over the first line, and that of the signal over the second wire, move a switch to open the local circuit of the relay, or small bell of the second line, which local circuit includes the gong and door opener. The line over which the first signal is sometimes called the "joker" line, while the other or second line is usually called the gong line.

We give the first claim: "1. A door opening electro magnetic device, an electric gong, and a battery in a wire common to two different local circuits, each of said local circuits containing a different switch, and each being mechanically independent of the other and connected through the circuit-closing points of a different relay, one of said relays being connected to be energized in unison with the signal sent over the joker-line of the system and the other of said relays being connected to be energized in unison with the signal sent over the gong-line of the system, in combination with said joker-line and gong-line, whereby the battery in said common wire may be closed to operate said door-opening electro-magnetic device and electric gong, by signals sent over both the joker-line and the gong-line, the gong-line alone, or neither of said lines, according to the positions of the switches."

382,272. Insulating Joint. James T. Robb, New York, N. Y.

Between the flanges of the two screw-threaded sleeves is placed a washer of flexible insulating material such as leather which has been soaked in oil, paraffine, or similar substance, to increase its flexibility and improve its insulating property.

382,279. Electro Magnetic Motor. Nikola Tesla, New York, N. Y.

We give claim 1. "The combination, with a motor containing independent inducing or energizing circuits, and closed induced circuits of an alternating current generator having induced or generating circuits corresponding to and connected with the energizing circuits of the motor."

382,280. Electrical Transmission of Power. Nikola Tesla, New York, N. Y.

In carrying out the invention a motor is employed in which there are two or more independent energizing circuits, through which are passed alternating currents which effect a progressive shifting of the magnetism of "the lines of force" which produces the action of the motor.

The claim is as follows: "The method herein described of electrically transmitting power, which consists in producing a continuously progressive shifting of the polarities of either or both elements (the armature or field magnet or magnets) of a motor by developing alternating currents in independent circuits, including the magnetizing coils of either or both elements."

382,281. Electrical Transmission of Power. Nikola Tesla, New York, N. Y.

"Claim. The method herein described of transmitting power by electro magnetic motors, which consists in continuously and progressively shifting the poles of one element of the motor by alternating currents and magnetizing the other element by a direct or continuous current."

382,282. Method of Converting and Distributing Electric currents. Nikola Tesla, New York, N. Y.

We give claim 2. "The method of electrical conversion and distribution herein described, which consists in generating in independent circuits producing an idnuctive field alternating currents in such order or manner as to produce by their conjoint effect a progressive shifting of the points of maximum effect of the field, and inducing thereby currents in the coils or convolutions of a circuit located within the inductive influence of the field."

C. F. DUNDERDALE,
Electrical Engineer,
154 La Salle St., CHICAGO, ILL.

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Kansas City Branch, INTER-STATE ELECTRIC CO., Kansas City, Mo.

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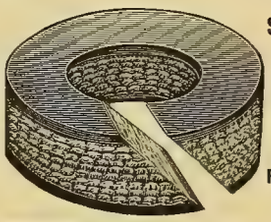

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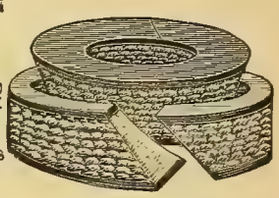

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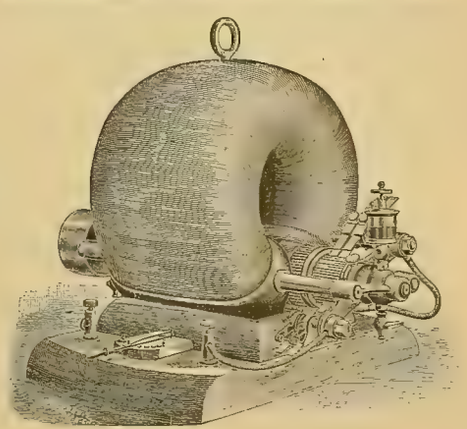

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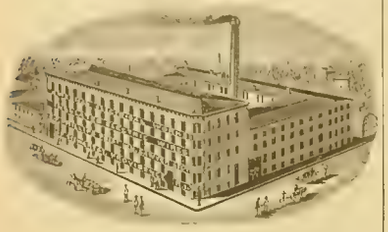

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"This was seconded by Alderman Conners and unanimously carried."

[Extract from Mayor Clark's speech.]

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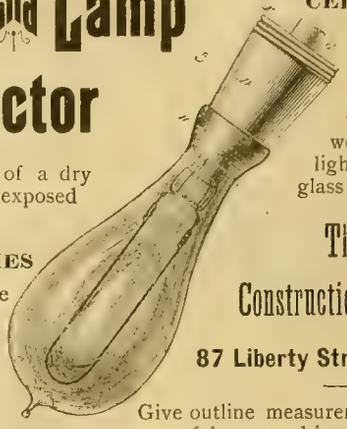

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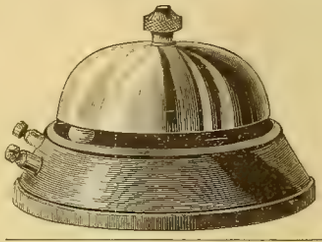

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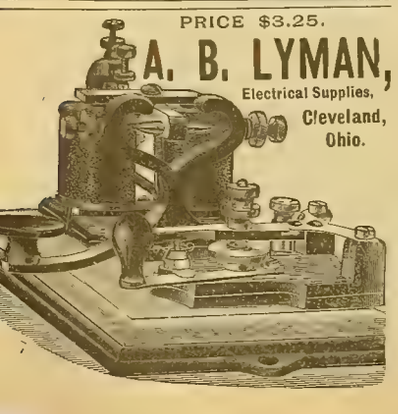

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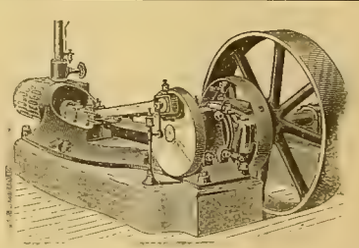

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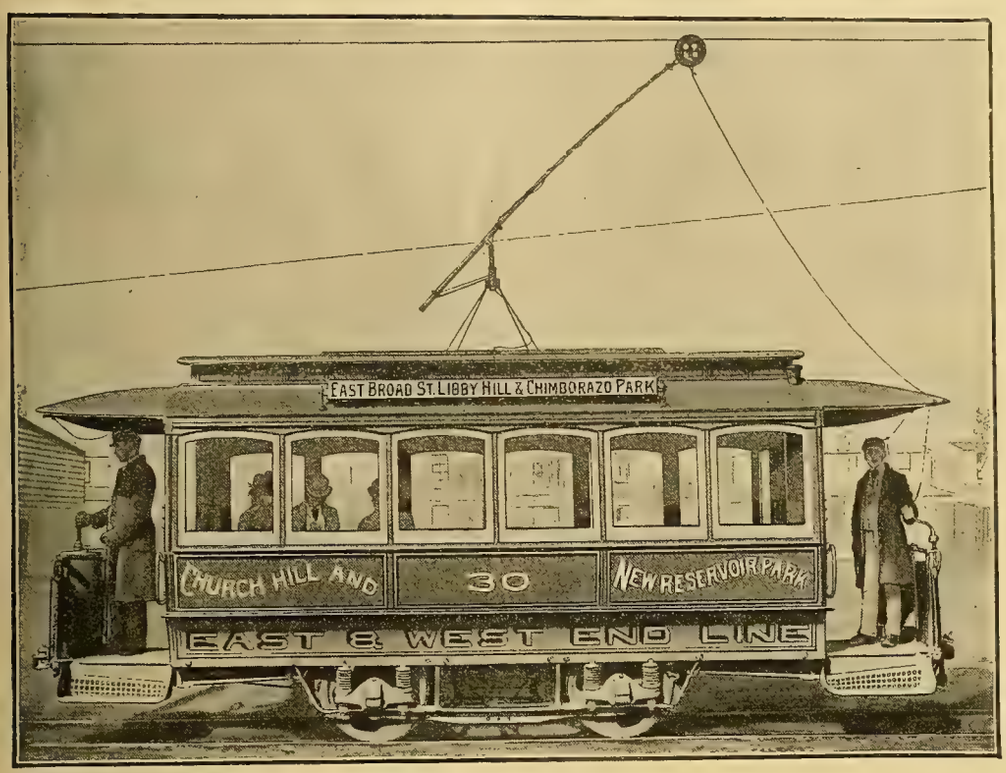

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Periods.	Cars put out.	Cars per day.	Miles made.	Miles per day.
February 2-15	118	8.4	3,874.5	276.7
February 16-29	158	11.3	6,625.5	473.2
March 1-15	194	12.9	11,273.5	751.6
March 16-31	251	15.7	17,419.5	1,088.7
April 1-15	273	18.2	21,025.0	1,401.7
Total			60,218	

Maximum run, 107 miles per day of 18 hours.

Periods.	Miles per Car.	Passengers carried.	Passengers per day.
February 2-15	32.8	25,450	1,817
February 16-29	41.9	38,437	2,746
March 1-15	58.1	49,656	2,311
March 16-31	69.4	67,887	4,243
April 1-15	77.0	86,173	5,745
Total		267,603	

Schedule running time, 7½ miles per hour.

The present mileage of 1,400 to 1,500 miles on these grades would require not less than 200 horses.

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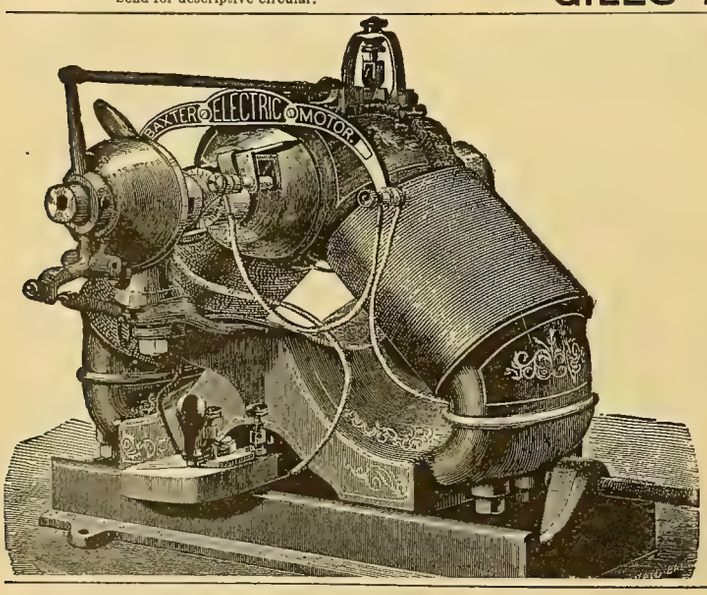

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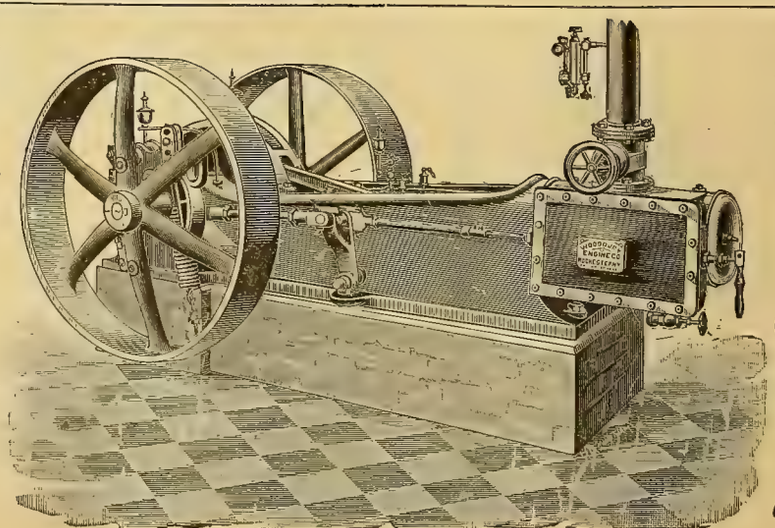

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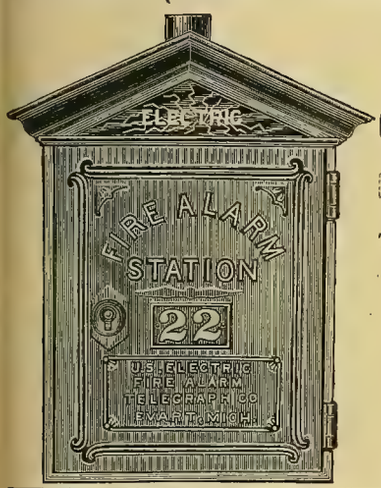

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SUPPLIES FOR ELECTRIC BELL WORK.

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The Parker-Russell Mining and Mfg. Co.

Electric Light Carbons

Adapted to all Systems.

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MANUFACTURERS OF

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CARBONS FOR ARC LAMPS, ETC.

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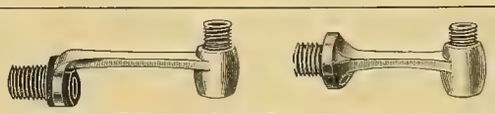

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FOR FITTING ELECTRIC LIGHT SOCKETS TO GAS FIXTURES.

No more burnt wire conductors where this attachment is used.

Remove gas burner, screw nozzle in its place; by replacing and screwing gas burner on nozzle, you effect a solid, permanent, gas tight job. Send orders to

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DYNAMO TENDERS' HAND-BOOK.—By F. B. BADT.

100 pages; 70 illustrations; flexible cloth binding; size of type page, 6x3 inches. Designed for Dynamo Tenders and Linemen, Stationary and Marine Engineers. Just the book for men who wish to learn how to operate and care for electric light installations. The only book of the kind in the English language.

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ELECTRIC LIGHT CARBONS.

Faraday Carbon Company.

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THE ELECTRICAL SUPPLY CO.

171 Randolph Street, CHICAGO.

MANUFACTURERS.

Chat.

The past week has been a busy one. Orders from our friends came in with a rush, but we were ready for them, and, with a few exceptions, where it was an absolute impossibility to ship from stock, manufacture, buy, borrow, beg, or steal the goods required, we think all our orders were filled to the complete satisfaction of our customers.

If we have failed to satisfy our friends, will they kindly **speak now.**

We must apologize for the post-office officials—catalogues have failed to reach some of our customers, and we know they were mailed, at least we saw them wrapped, addressed, stamped and started for the post-office in the grip sack of our young Volt—from tests made, are sure they were not grounded before reaching the post-office.

Catalogues will be mailed free to any post-office official, upon application.

Customers will oblige us very much by at once notifying us of any delays.

Will our friends who were in the city last week and did not call on us kindly explain. Sorry not to see you.

Our Stock.

P. & B. Line Wire,
Underwriters Wire,
Magnet Wire,
Office Wire,
Annunciator Wire,

Kerite Wires and Cables,

TESTING INSTRUMENTS,

Carbons for Electric Lighting,

Cotton, Silk and Kerite Cords for Incandescent Lamps.

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of every nature used in connection with the construction or operation of Electric Light Plants. (Please give this a trial.)

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Why?

We can give you low prices because we manufacture our goods. We can give you first-class goods for the same reason. We can ship from **Chicago** promptly because we have on hand the largest and best assorted stock of electrical goods in the country. You must excuse our saying so—our friends who want your trade won't tell you, and it certainly is our business to let you know. We would be neglecting our duty if we did not do so.

Why?

We have printed, for your use, a number of special catalogues. The catalogues are not reprints of some that came out of the ark, or even the Mayflower; they are new and represent our stock. Kindly examine them. Shall be pleased to mail catalogues to any address. Write for them.

PROMPT ATTENTION. BEST QUALITY. LOW PRICES.

Factories, ANSONIA, CONN. Branch Office, 125 West Sixth Street, KANSAS, CITY.

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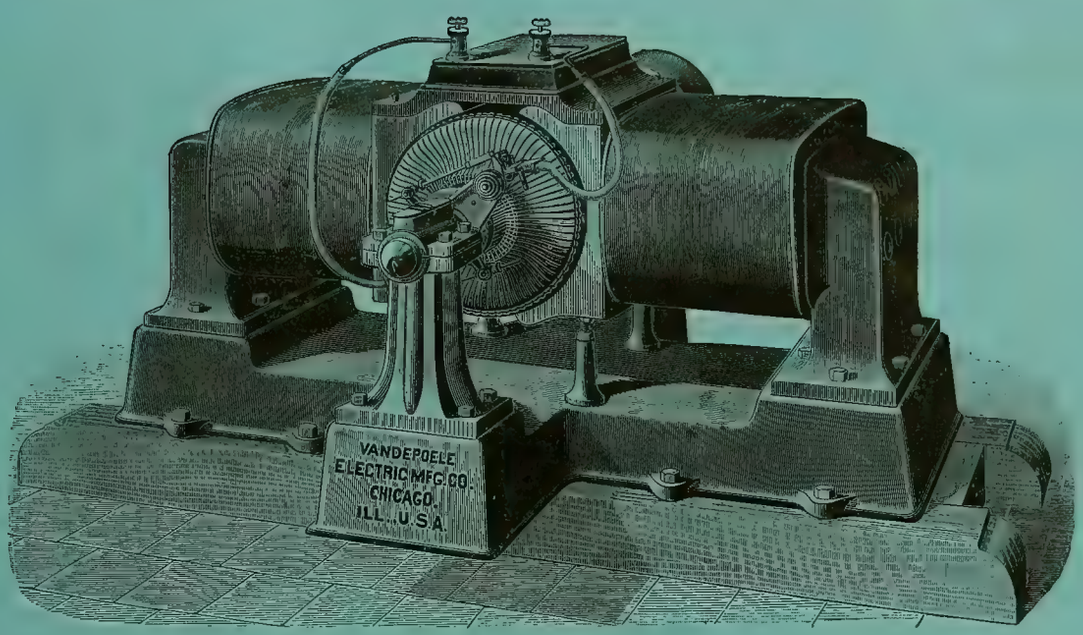
VAN DEPOELE

ELECTRIC LIGHT SYSTEM



We solicit the patronage of those who want the *Best Electric Light for the Least Money.* Estimates and other particulars sent on application. **3,500** lights now burning.

MUNICIPAL LIGHTING OUR SPECIALTY.

We claim for the Van Depoele Improved Arc Lamp that it is the simplest and best lamp in existence; for our dynamos, that they cannot get out of order, and require little or no attention, that an inexperienced man can run them, and that they give the most light for the least consumption of power.

Manufactured and for sale only by

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MANUFACTURED AND CONTROLLED BY THE

Fort Wayne Jenney Electric Light Company,

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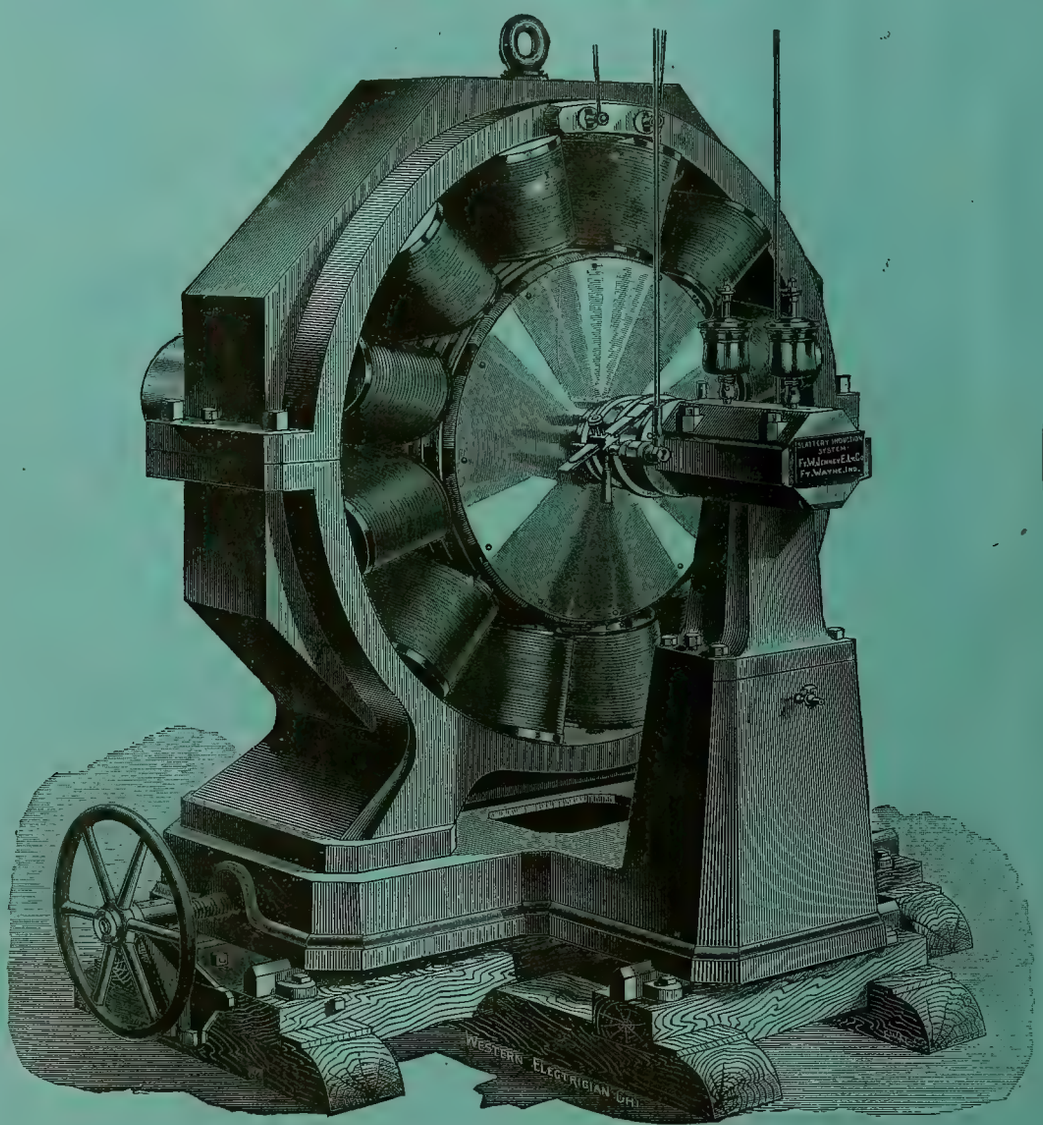
The most carefully worked out and complete Alternating System of Electric Lighting in Existence.

ARMATURE Converter Guaranteed



12 16 Candle Power Lamps TO THE Horse Power Guaranteed.

SLATTERY ALTERNATING DYNAMO.

Fort Wayne Jenney Electric Light Company,

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AND

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$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. II. CHICAGO, MAY 19, 1888. No. 20.

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Electric Light Globes, Shades,

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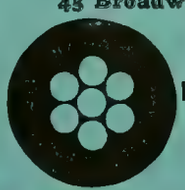

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Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

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The acknowledged Standard for durable and high Insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

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Concealed Wiring in all Locations.

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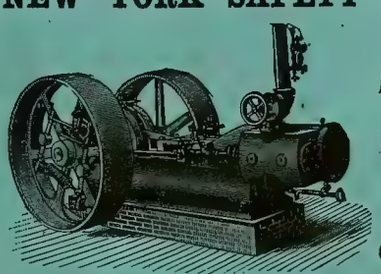

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SPECIALLY ADAPTED FOR RUNNING

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And other duty requiring close regulation of speed.

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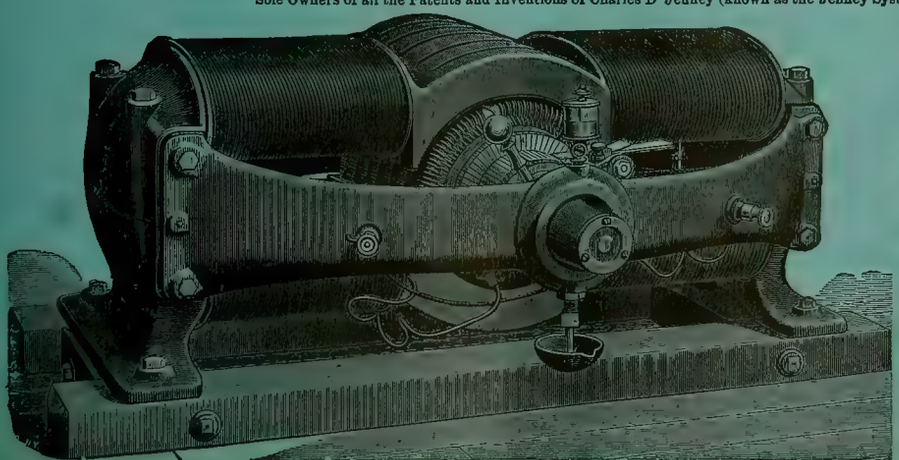
INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp & Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison.

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

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This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

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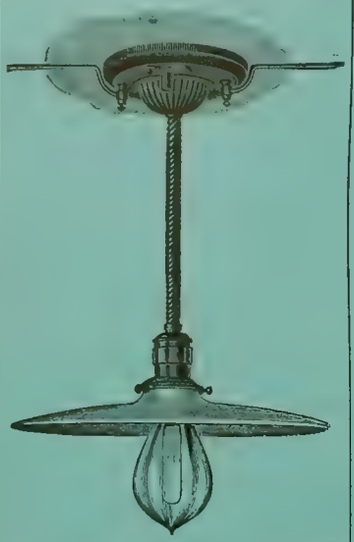

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These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
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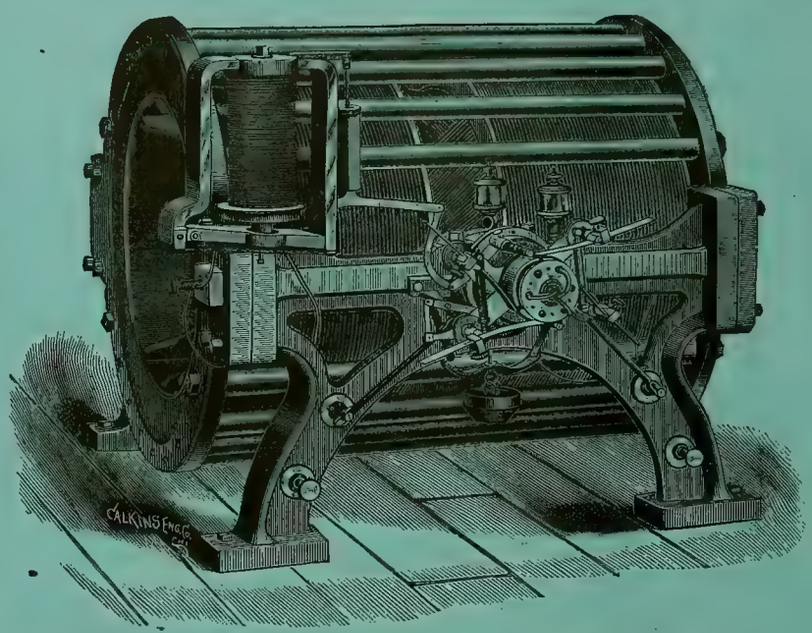
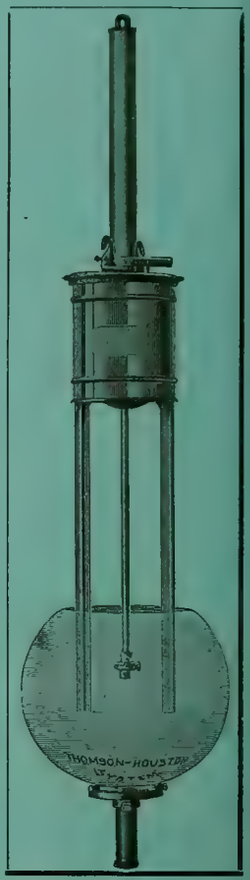


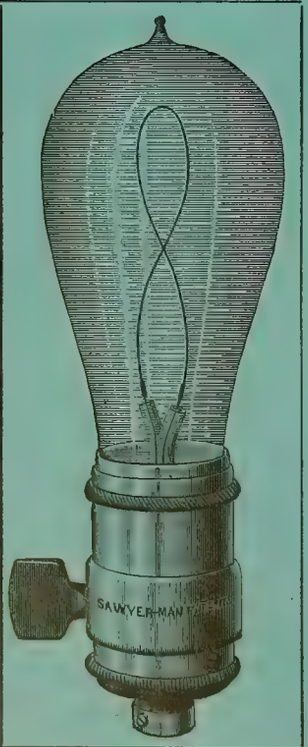


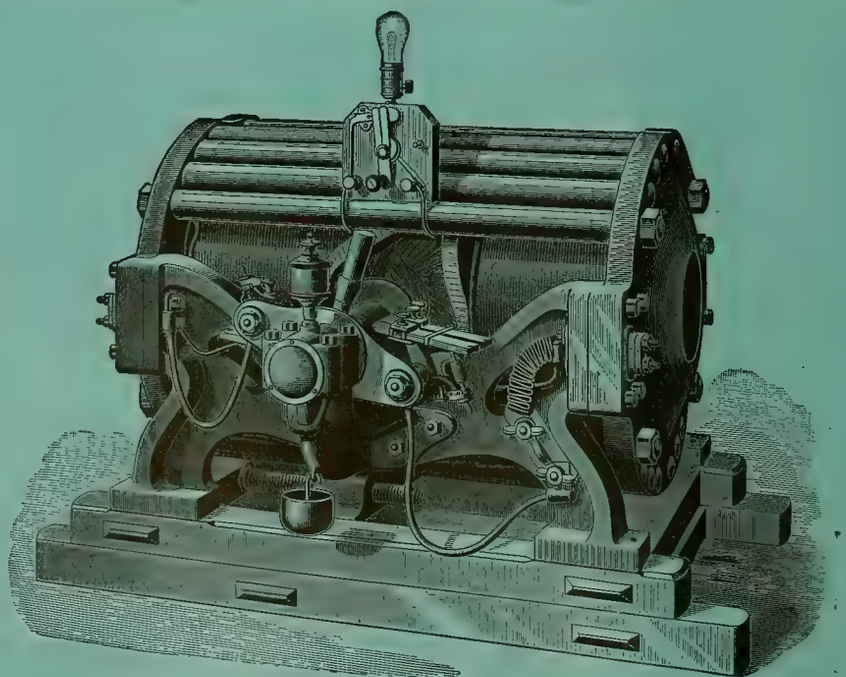
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS.

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

Chicago & Northwestern R. R.

Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.
G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

LEONARD & IZARD, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(SIGNED) G. H. THAYER, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{50}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

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IS THE ONLY MANUFACTURER IN THIS COUNTRY USING

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and it is conceded by all experts as **superior** to every other insulation for **UNDER WATER** and **UNDERGROUND**—when not subjected to excessive heat.

We have the oldest plant in the United States for **INSULATING ELECTRICAL WIRES**, and we are prepared to manufacture wires of **HIGH INSULATION** for every **Electrical Purpose,** from the finest **Magnet Wire** to the **Heaviest Cable,** and to fully guarantee them as to **QUALITY** and **DURABILITY.** We are the only manufacturers of

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which is **superior** to all other compounds for **BATTERY COPPERS, SWITCH BOARDS** and **INSTRUMENT CONNECTIONS.** Our

Balata Flexible Cords

are absolutely **WATER** and **ACID PROOF,** and have no equals for movable **INCANDESCENT LIGHTS, SWITCHES** or **BATTERY CORDS.** Our

Rubber Compound Insulation

for **ELECTRIC LIGHT AND AERIAL USE—a new feature with us**—is under the direct charge of an expert, who was twenty years superintendent for Siemens, of London, and has had more experience than any other man in America in insulating wires.

We employ in every department the **best attainable talent** and use only the **PUREST MATERIALS** and the most improved machinery, besides much especially devised by our experts.

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The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

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For information relative to Central Station Business, apply to the

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SUCCESSORS TO THE

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OWNERS OF THE SAWYER-MAN PATENTS.

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Plans and Estimates Furnished for all kinds of Incandescent Lighting.

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES.

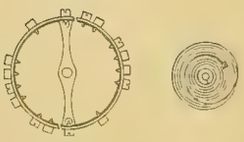
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**

These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

FOR SALE BY ALL FIRST-CLASS JEWELERS.

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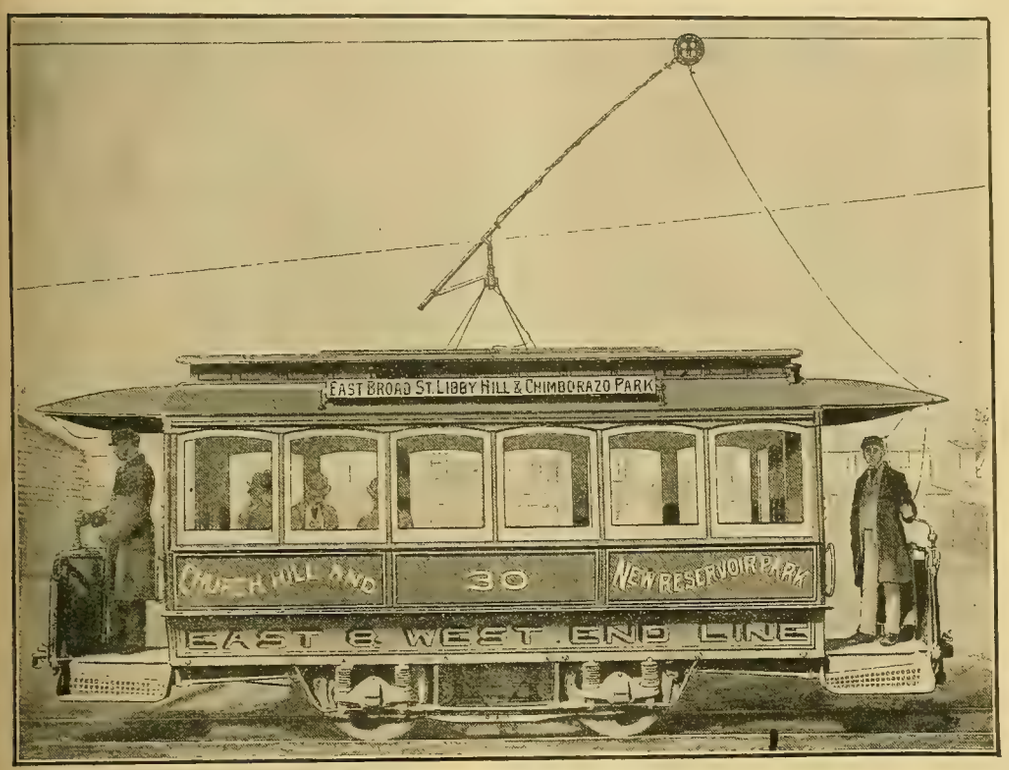
Factory: 510 to 516 W. 30th St., N. Y.
and Schenectady, N. Y.

Branch Offices: Boston: 55 Oliver St. Philadelphia: 119 South 4th St. Cleveland, O.: 117 Public Square. Detroit: 133 Jefferson Ave. Chicago: 185 Dearborn St. Western Engineering Co., Lincoln, Neb. Cor. Broadway and Thatcher St., Albany, N. Y. Aspen, Colorado. Seattle, Washington Territory. St. Louis: 304 Locust St. Topeka: 700 Kansas Ave. Louisville: 439 West Main St. New Orleans: 20 Carondelet St. Laramie, Wyoming.



This is the only company in the United States devoting its entire energies to the various questions involved in the transmission of power, railway and stationary, and is putting into practical use more motors of and over one-half horse power than all other companies combined.

This company having now perfected a Street Railway System in all its details, is prepared, under suitable guarantees of successful operation, to take contracts for equipping new roads with all the appliances, both electrical and mechanical, for operating street railroads, and also for equipping roads now in operation.

We have roads successfully running in **Richmond, Va., Carbondale, Pa., St. Joseph, Mo., Wilkesbarre, Pa., Wilmington, Del.,** and are equipping roads in a number of other cities. We give below partial data as to one road, that in Richmond, Va.

There the Sprague Company is operating the most extensive, difficult and successful electric street railway in the world, and the attention of railroad men is called to the following facts as to the operating of the Richmond Union Passenger Railway:

The total trackage is **12 miles.** Streets covered, **9 miles.** Maximum grade, **10 1-10 per cent.** Longest grade is **5,600 feet,** varying from **2 to 8 per cent.** The curves are **39 in number;** such as **27 foot radius with 5 per cent. grade;** 40 foot radius, with 8½ per cent. grade, etc. Ten miles of the road are now operated, being the heaviest part with about a mile of up grade each way. **Total equipment is 40 cars.** Twenty closed cars are now in operation. These cars are full-sized 16 foot closed cars. The 22 foot open cars are now being equipped.

Note the facts for the first few weeks' operation, from the following fortnightly table:

Periods.	Cars put out.	Cars per day.	Miles made.	Miles per day.
February 2-15	118	8.4	3,874.5	276.7
February 16-29	158	11.3	6,625.5	473.2
March 1-15	194	12.9	11,273.5	751.6
March 16-31	251	15.7	17,419.5	1,088.7
April 1-15	273	18.2	21,025.0	1,401.7
Total			60,218	

Maximum run, 107 miles per day of 18 hours.

Periods.	Miles per Car.	Passengers carried.	Passengers per day.
February 2-15	32.8	25,450	1,817
February 16-29	41.9	38,437	2,746
March 1-15	58.1	49,656	2,311
March 16-31	69.4	67,887	4,243
April 1-15	77.0	86,173	5,745
Total		267,603	

Schedule running time, 7½ miles per hour.

The present mileage of 1,400 to 1,500 miles on these grades would require not less than 200 horses.

The entire operating expenses chargeable at the central station for **20 cars,** with the present mileage, on the **heaviest section** of the track, is only **2 cents per car mile.** This includes **Electrician, Engineers, Firemen, Dynamo Men, all Coal, Oil, Waste, Water, Lighting and Depreciation;** the working force being, with the exception of one man, sufficient to handle 40 cars. When the 40 cars are in operation the expenses will be reduced to about **1¾ cents per car mile run.**

Send for Map and Details of this Road.

The Sprague Company is now entirely ready to take contracts for equipping roads of any size.

CHARACTERISTICS OF SPRAGUE RAILWAY MOTORS.

Lightest weight consistent with highest efficiency. Simple, compact in construction. Non-liability to get out of order. No skilled labor. Strong enough to do the work under all conditions. Simplicity and ease of operation. Commutator wear reduced to a Minimum.

DETAILS OF SYSTEM.

Generators of highest efficiency and reliability. Systems of conducting current to the cars with the impossibility of an accident at any point of the line interfering with the operation of the remainder of the road. Motors flexibly suspended from the axles to insure perfection of running. Greatly increased traction by the application of Motors to each axle with independent driving. Greatest return for given amount of coal burned. Freedom from disagreeable noises. Absence of all ropes, belts, sprocket-wheels and chains. No useful room in the car taken up by the motor. No changes in truck. No complicated nest of gearing. Use of single sets of brushes for both directions of driving. Single movement control.

AMERICAN SYSTEM

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ELECTRIC LIGHTING.

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American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

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Line Wire and Equipment, Pins, Brackets, Cross-arms, Insulators, Etc., Insulated Wire and Cables.

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ENGINES.

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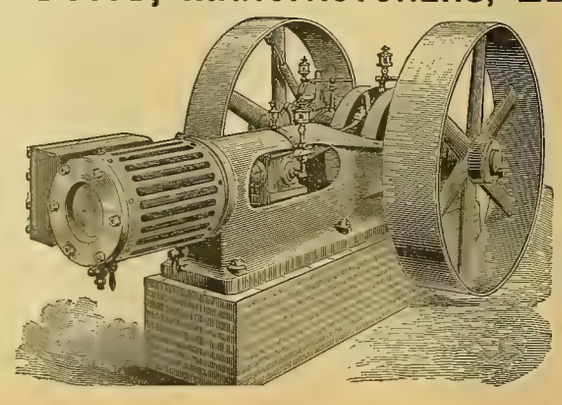
Specially Adapted for Electric Lighting.



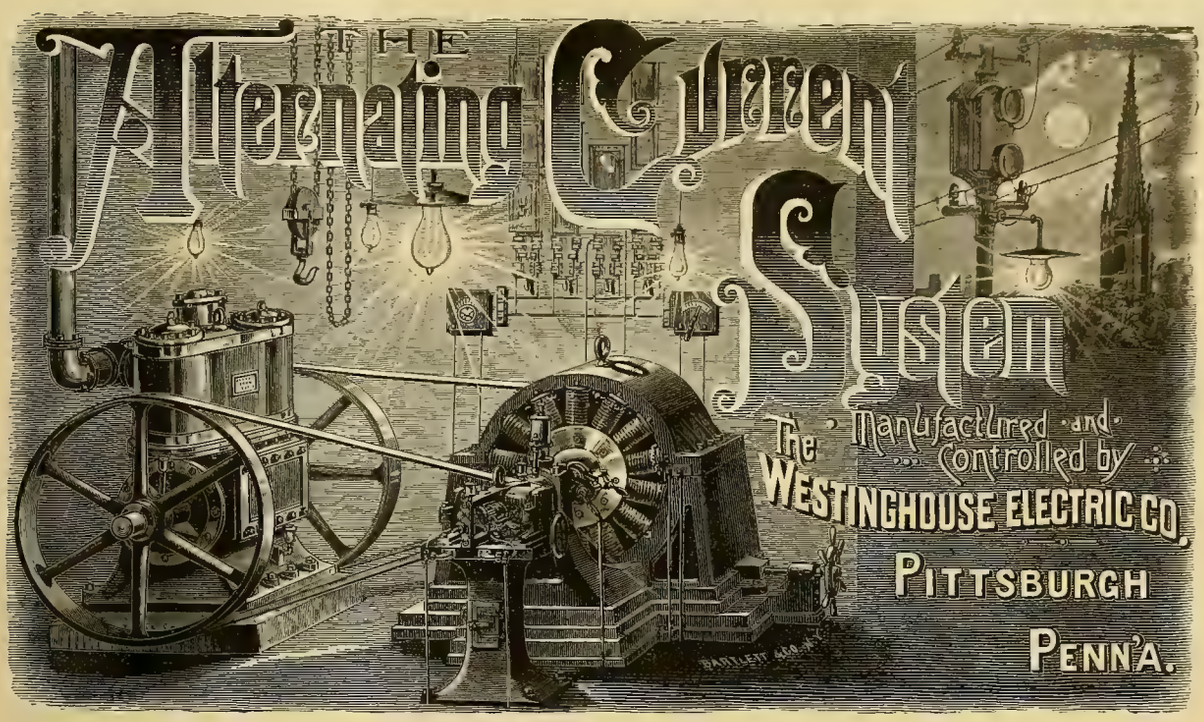
WESTERN DEPARTMENT:

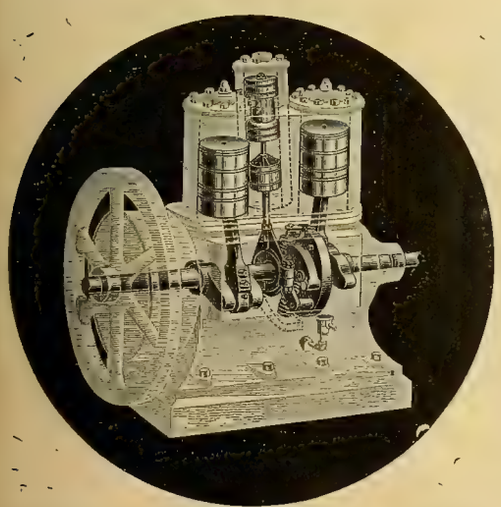
No. 10 S. Canal St.

CHICAGO.

H. S. WALKER, MANAGER.

TELEPHONE 4024.





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Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

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IN ALL KINDS OF

ELECTRICAL SUPPLIES.

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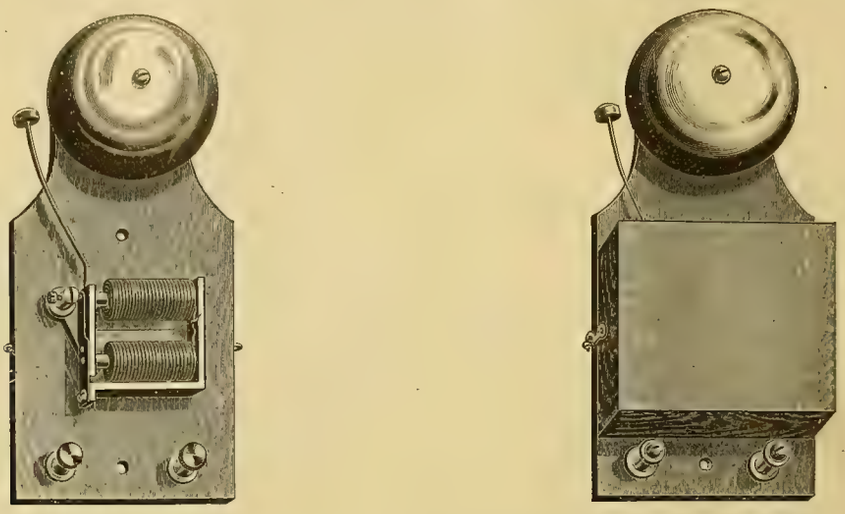

THE ABOVE CUTS REPRESENT THE

Western Electric Walnut Box Bell.

The workmanship and finish being up to our usual standard is a guarantee that it is the best Bell for the money now upon the market.

EACH BELL PACKED IN NEAT PASTE BOARD BOX.

DIMENSIONS.

Back,	7 x 3 1-8 in.
Box,	3 1-8 x 2 13-16 x 1 1-5 in.
Resistance,	3 to 4 ohms.

We will send a sample Bell to any part of the United States by mail, postage prepaid, on receipt of seventy-five cents.

SPECIAL PRICES ON QUANTITIES FURNISHED ON APPLICATION.

WESTERN ELECTRIC COMPANY,

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Western Electrician.

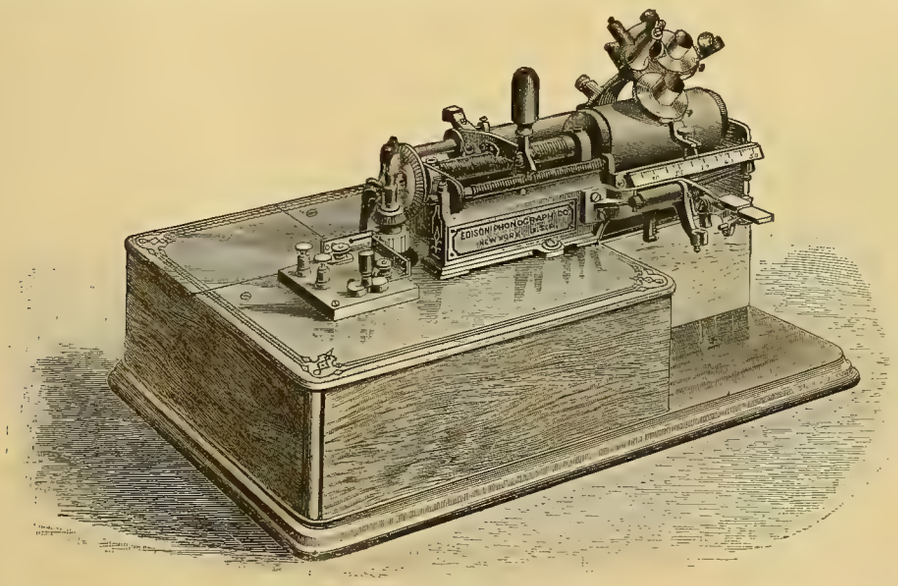
EVERY SATURDAY

Vol. II. CHICAGO, MAY 19, 1888. No. 20.

The Edison Perfected Phonograph.

Mr. Edison gave an exhibition of his perfected phonograph at his new laboratory at Lewellyn Park, Orange, N. Y., May 11th. The building into which he moved three months ago is 200x75 feet and is three stories in height. The library which is on the first floor contains 16,000 scientific works, many of them exceedingly rare and valuable. The rooms and shops for experimental work only are on the second floor; no manufacturing is carried on there. In the lecture room on the third floor Mr. Edison gave the public tests of his phonograph. Three of the instruments were screwed to tables in different parts of the room. A cut of the phonograph is given herewith.

It consists of a box about eleven inches square, which contains the motor. The armature is simply a ring of metal placed horizontally, with ten pole pieces or bars around the rim. The box also contains the eccentric governor. The shaft on which the hollow receiving cylinder is placed is four inches long, and has 100 threads to the inch. The shaft feeds the spectacle, containing



in one ring the transmitter and receiver. The recorder is a steel knife fastened to the diaphragm, and the receiver is a delicate metal needle, operating on what are called phonograph blanks, which are cylinders of wax or composition metal. These are what the impressions are made on, and they taper inside so as to bind on the shaft.

In the operation of the phonograph a little key is shifted on top of the box containing the motor, and with a perfectly steady motion the cylinder begins to revolve. The operator then, in an ordinary tone of voice, speaks into the "recorder" eye of brass spectacle. As he talks the diaphragm vibrates and a tiny metal point affixed to its under side begins to mark lines of varying depth and regularity on the wax cylinder. When his remarks are finished the operator turns a key which lifts the recorder out of the way and brings the reproducer into its place, the cylinder is shifted back to its starting point, the motor set running again, and the delicate little membrane, which has like the recorder a tiny point affixed to it, begins to give back in low, but clean and distinct tones the words which have been spoken.

In principle the phonograph is the same as that which was exhibited about ten years ago. One of the few which were manufactured at that time was exhibited in the First Methodist church in Chicago, and excited the greatest interest. The appearance of the instrument is decidedly different from the cumbersome phonograph of ten years ago with its metallic and indistinct tone.

Last Saturday evening E. T. Gilliland, Mr. Edison's right hand man, read a paper on the phonograph and its development, at the New York Electric club. Among those present were the following :

Gen. W. T. Sherman, Col. Robert G. Ingersoll, Dr. Robert Collyer, Leonard E. Curtis, Marshall P. Wilder, Prof. Charles R. Cross, of the Massachusetts Institute of Technology, Prof. George W. Plympton, of Brooklyn, W. B. Sommerville of the Western Union company, Walter P. Phillips of the United Press association, Gen. O. E. Madden, Allen Thorndike Rice, Col. W. H. Eckert, Lieut. F. P. Toppan, U. S. N.; Bishop Foster, and Capt. Henry Irving, U. S. N.; Theodore Thomas, W. D. Howells the novelist, G. P. Lathrop, and a large number of scientists and professional gentlemen. Mr. Gilliland illustrated his paper with 100 drawings thrown by a stereopticon upon a screen. The slides illustrated the original instrument and the steps in its development Prof. Robert Spice followed and by the aid of drawings illustrated the principle by which the sound waves were recorded on the wax cylinders.

For convenience sake nine of the ten instruments shown were limited to reproducing. Conversations, recitations by Marshall Wilder, cornet solos which had been recorded were reproduced with a fidelity which astounded the hearers. Of his invention Mr. Edison says, "The phonograph will be able to reproduce orchestral pieces and can be so made that it will record with exactness operas and the solos of great singers. All our business is now carried on by means of phonographs. We save time for the person who dictates and for the typewriter copyist. They need not be together at the same time. I can dictate whenever it is most convenient and leave the typewriter to take it off by his machine whenever he comes to the office. It all comes out perfectly clear, and there is scarcely any correction of the typed correspondence. Besides we don't need now to have a man who understands stenography, because the copyist hears the words just as we speak them; and the phonograph, by pressing one key, can be made to stop speaking and then go on when the copyist is ready, or by pressing another key he can make the machine repeat as often as he wants anything that he doesn't understand at first. The wax blanks, containing the memoranda, can be stripped off the cylinder and kept for reference. We have a process of reproducing them to any amount from a single talking. The original cylinder or the copies may be mailed anywhere, supposing you have dictated a letter on them, and then put on to another phonograph and made to talk. We have made mailing-boxes for this purpose, to carry the wax cylinders, and they will carry all right, for we have tested the boxes by throwing them up to a high ceiling and letting them fall, to see whether the shock injured the wax inside the box. Then, speaking of practical uses, we are now able to put a phonograph cylinder at the telephone and make it talk to some one in New York by wire. This we have done repeatedly. We break ground at once for building a big phonograph factory 600 feet long and 75 feet wide. The contract is signed, by which it is to be finished in two months, and the machinery is all ordered. We've got three acres of ground for the factory, and all the plant."

The phonographs will probably be on the market in two weeks.

Reducing Refractory Ores by Electricity.

It has been found necessary by many mining companies to throw away large amounts of ore because no means for reducing them economically were known. The Iron Silver Mining company of Leadville has recently been experimenting with a new process, the success of which seems to be assured. The ores on which the tests were made contained a small per cent. of precious metals so combined with base metals that the usual methods of reduction could not profitably be employed. The process employed is electrical and is the invention of H. B. Slater of Detroit. By means of the new process the smelting charge is reduced and ores which have been considered absolutely worthless are found to yield a large profit.

The Short Series System of Electrical Railways.

In connection are shown several illustrations of the Short series system of electrical railways manufactured by Sidney H. Short & Co. of Columbus, O., and which has received practical demonstration in that city.

Either overhead or underground conductors are used with this system, the former being illustrated by Figs. 1 and 6 and the latter by Fig. 2. In Fig. 6 it will be noted that the objection to wooden poles on the street of a city is entirely removed by the use of iron arches, which span the street only at street intersections. Suspended from these arches are steel wire cables parallel with the street, to which the supports for the electrical conductors are attached. These supports are sufficiently close together to form a level track of the wires upon which the current collector travels. The arches support the electric lamps and their supply wires and so remove all necessity for poles on the streets.

Fig. 1 shows a single iron arch which is intended to be used in narrow streets, and on single tracks with turnouts, but it is in many cases used with double tracks. It is constructed in the same manner as the double arch, and is very graceful and ornamental. Should the conductor in the elevated construction in any way be broken, no injury would result from their coming in contact with any person as in this system the moment the break occurs the electric generator at

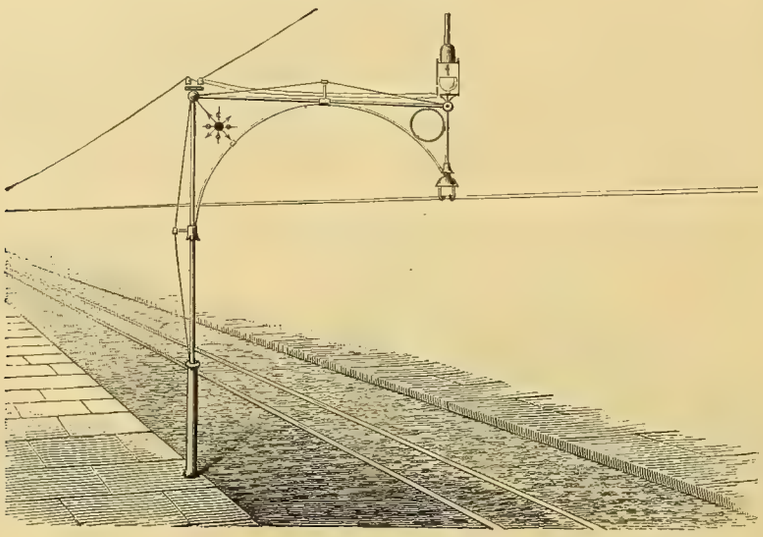


Fig. 1.

the station automatically stops. Telephone and telegraph wires falling upon these conductors will not interfere with the running of the road. The system is harmless to man or beast.

The current collector which moves along on the elevated conductors weighs but six pounds and is entirely new in construction, embodying principles which make it impossible for it to leave the wires. The collector receives its power from one wire and transmits it to the motor which returns it to the other wire to be carried on to another motor. The electric energy is not allowed to come in contact with any part of the track or with the earth.

The construction of the conduit used in this system is shown by Fig. 2. The ties, yoke and slot rail are all of steel and firmly riveted together into one structure. The conduit itself is formed of cement and stone. The small size of the conduit—fifteen inches deep—makes it possible to construct it at small cost, and yet have it substantial. The conductors which are placed in this conduit are small copper wires, such as are used on the elevated lines, supported on peculiar porcelain insulating brackets at short intervals. It is not required in this system to use massive conductors to transmit power, for one hundred cars can be run on the current carried by a small wire as well as one car. The current collector travels on these conduit conductors in the same manner as on the elevated conductors.

Fig. 3 is a perspective view of the car preferred for use in this system, a part of the body of the car being removed to show the position of the motor. The front compartments are all prepared to be fastened to the car in place of the front platform and hood and are easily applied to any of the cars now in use. This position removes the motor from the dust and dirt of the street, leaves the gearing all in place, and provides a clean, dry and warm room for the car driver. The front window can be let down in warm weather for better ventilation of the car. The motor is immediately under the eye of the driver, and perfect oiling and attention are insured. Another position is between the axles of the car and entirely concealed by the floor above and a dust tight box around it. This position leaves the entire car and both platforms free for passengers. The motor is controlled from either platform with perfect ease. The third position is in a separate car to be attached to the passenger coaches. In many cases a portion of this motor car is utilized as a smoking car. The cars are lighted with incandescent electric lamps, and electric headlights are attached to the front of the cars.

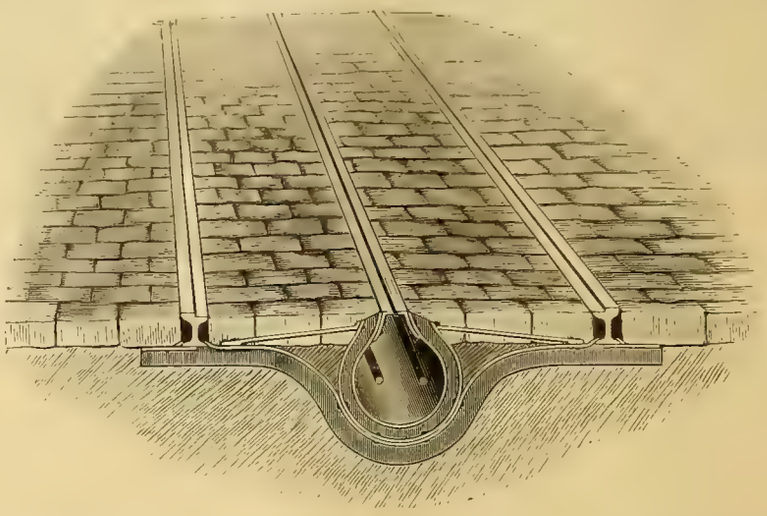


Fig. 2.

It is necessary in the transmission of power from the motor to the car wheels to use the most direct and positive method known to mechanics. Accordingly the company have adopted spur gearing, Fig. 4., as this precludes the possibility of a failure in action and gives the least possible loss in transmitting the power. They use gear wheels of cast steel cut with great precision, and pinions made from rawhide held firmly between plates of steel. The teeth of these pinions are cut to match accurately the teeth in the gear wheels so as to have a train of gears which run at any speed with absolutely no noise.

The motor truck, mounted on the standard car wheels and axles, arranged to receive the car bodies of any make or size, is furnished complete, as shown by Fig. 5, and geared to run at any desired speed. The motor is supported on a steel framework attached to the axles of the car with bearings of the best make and provided with continous feed oilers. This is a strong framed locomotive within itself and is changed from under the box to the open cars with the season. No other appliance than is shown in this cut is used for regulating the speed or direction of motion. No resistance coils, switches or other electrical devices are used in this system of electrical railway.

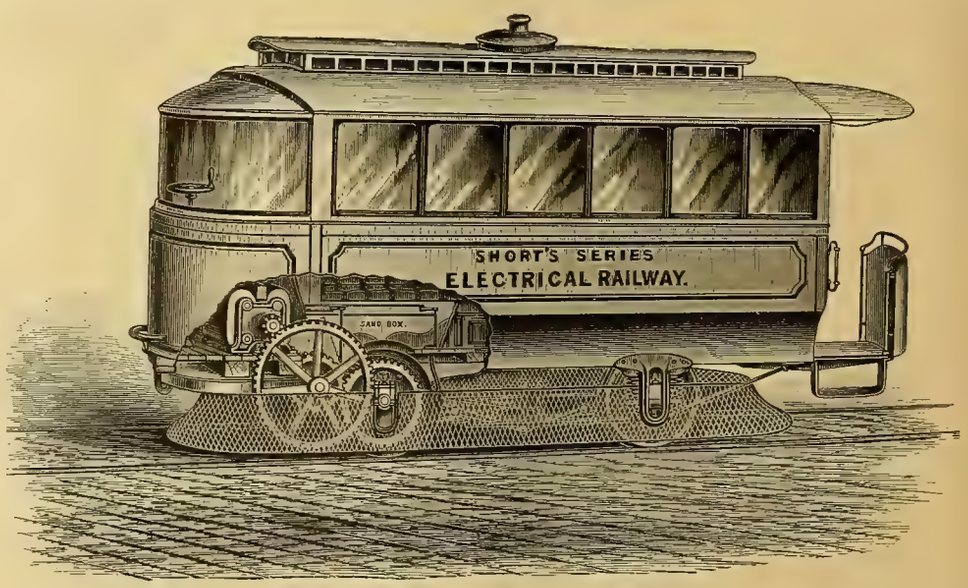


Fig. 3.

The company after considerable experimenting have adopted and recommend the Brush dynamo for a generator.

Dynamo Tenders and Life Insurance.

It will be a matter of no little interest to a large number of persons who have in charge electric lighting apparatus to know that they are not considered eligible for membership in at least one benevolent insurance company. A short time ago two engineers who have charge of an isolated electric light plant were asked to join a new lodge of the Royal League of Chicago. They decided to make applications for membership and after they had done so it was found they were ineligible. By the rule adopted by the supreme council of the order no person can be admitted who is engaged in handling electric light apparatus. The engineers felt aggrieved as they do not consider their calling hazardous. Those who were interested in forming the new lodge thought that the rule of the council was unjust as it shut out without distinction all those engaged in furnishing electric light.

A gentleman who is interested in securing the new charter for the lodge said to a representative of the WESTERN ELECTRICIAN, "We do not consider that the council is justified in excluding those who are in charge of dynamos. Certainly there is far less risk attending the care of a dynamo than in running a stationary engine. An extraordinarily careless man might be killed by a dynamo but it seems to me that such a blunderer would never give the dynamo a chance at him. He would be killed by the engine before the dynamo could have half an opportunity. I am a member of the league and I work for its interests and I don't wish to see persons whose lives are constantly in danger admitted to membership. But I don't think the dynamo tenders can be considered in that class by any means."

One of the engineers referred to said, "If this rule of the Royal League stands, it is not unlikely that the example will be followed by other similar organizations, and all of us in charge of plants will find it hard to secure insurance anywhere. The work of caring for a dynamo is not dangerous. If the league wishes to discriminate against linemen perhaps not as much could be said, for they are killed once in while but it is not often that a man in charge of a dynamo has any accident."

C. A. Warren, supreme scribe of the Royal League, was called upon. He was ready to explain the position which the council had taken. "The league," said Mr. Warren "only takes first-class risks. For example, we will not accept saloon keepers. It is not on the ground of morality that they are rejected but because they are extremely poor risks. Other callings which are found by statistics to have a high death rate debar applicants from membership. Now it was with this idea in view that the supreme council passed the rule making all those ineligible who have anything to do with the handling of electric light apparatus. The rule as it stands makes no distinction. Perhaps it should do so. The dynamo tender's occupation may be such that he would come under the head of a first class risk. I am now trying to get some statistics on this matter. I have written to officers of several electric light companies asking for information on this point."

"Then if you find that the calling is not dangerous you think that the council will be open to conviction?"

"Yes, certainly. Perhaps only linemen should be excluded. Their occupation is certainly dangerous. I read in the paper this morning of the death of a lineman in New York. The council only wishes to do what is just both to the organization and to those who wish to become members."

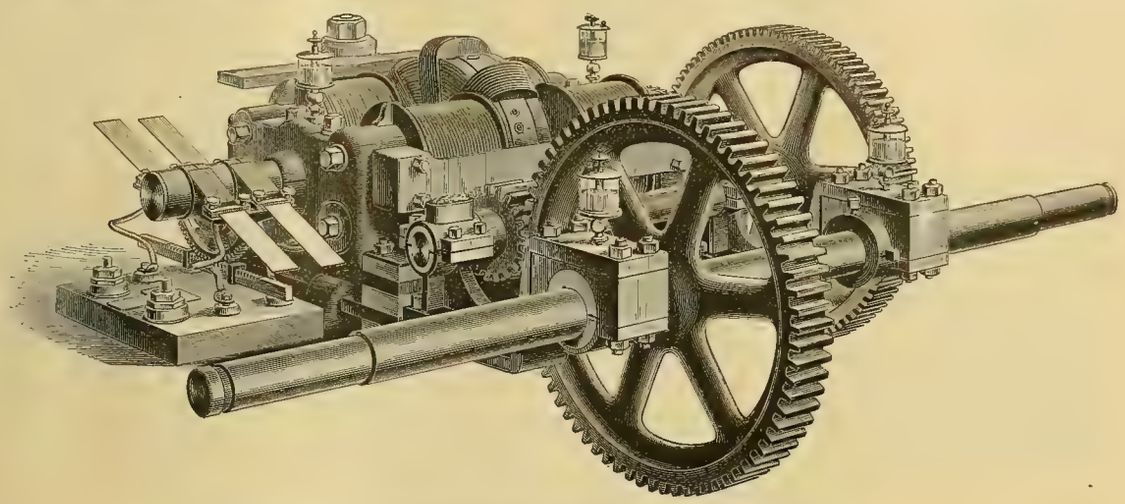


FIG. 4.—THE SHORT SERIES SYSTEM OF ELECTRICAL RAILWAYS.

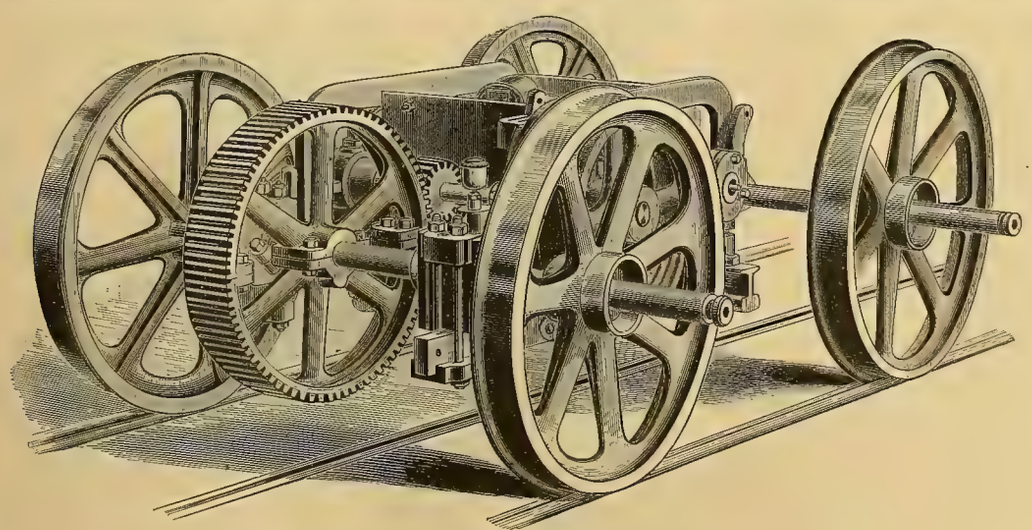


FIG. 5.—THE SHORT SERIES SYSTEM OF ELECTRICAL RAILWAYS.

New Haven Clock Company Sued.

Leroy B. Firman, of Chicago, and the Western Electric company of Chicago, have begun suit against the New Haven Clock company. The action is brought to restain the defendant company from manufacturing district telegraph signal boxes which it is alleged are infringements of the Firman patent. This patent is number 192,644 and was issued July 2, 1887. The Western Electric company holds the sole right to manufacture under the patent east of the Rocky mountains. George P. Barton is plaintiffs' attorney.

Long Lived Edison Lamps.

One of the most complete incandescent light plants in Chicago is that of the Union League club and nothing but praise can be given to the system in operation there. Not the least remarkable feature of the plant is its record of lamp life. The following figures were kindly furnished by the engineer, G. M. Cowan: The experimental test of the plant was made in June, 1886, but it did not commence running regularly until the following August. According to the record there are between 200 and 300 lamps which have had thus far a life of 4,300 hours. The average life of the lamps has been 2,700 hours and at least 5 per cent. of these lamps have been carelessly broken.

There are several reasons which Mr. Cowan assigns for this remarkable record. In the first place, he says, he has been exceedingly careful not to exceed the candle power of his lamps at any time. He has been careful in starting the dynamos. The wiring of the building, too, was excellently done.

Anyone who visits the Union League building will notice at once the artistic manner in which the lights have been arranged. This is a matter which is so often neglected as H. Swan said in a recent paper on artistic electric lighting. Incandescent lights may be so arranged that they will illuminate and decorate at the same time and this double purpose has been served in this installation.

Greater attention to this branch of work will tend to popularize the electric light and tend to establish a belief that the electric light is in truth the ideal illuminant.

The Waterhouse Incandescent Dynamo.

The Waterhouse system of long distance series incandescent electric lighting is coming to the front as a competitor of the alternating current systems. Its merits are that it uses small wire circuits of from number 8 to 5 B. and S. gauge; lamps that are arranged with a simple automatic shunt cut out so that in case the filament gives away, the remaining lamps are not affected; fixtures and mountings on the lamps that are completely insulated from any possible shock to a person standing on the ground and handling the lamps while in operation, and a system of instantaneous regulation of current from the dynamo that insures a steady light from the incandescent lamps, without the wavering effect usual on series lamps due to the sluggishness of the regulation. This enables the lamps to be burned at their full normal candle power without danger of straining them beyond this point, which secures a long life to the lamps and avoidance of blackening of the globes from deflagration of the carbon of the filament, the natural result of overstrained filaments. Owing to the difficulty of getting an even motion from the best forms of automatic cut off engines, which rarely regulate the speed in practice within five per cent. of the normal, the unevenness of candle power of incandescent lamps is often noticed. In the Waterhouse system this is compensated for by the balancing of the currents out and through the helices of the field magnets, by means of the regulator, which does its work so rapidly, that a change of load on the circuit is hardly noticed on an ammeter needle placed in the circuit, which is usually more sensitive to the current, and indicates changes more quickly than an incandescent lamp filament through its changes of candle power caused by vibrations of the current when a portion of the load is suddenly turned off.

The lamp used is for different candle powers. That for street lighting is for 25 candle power with a current of 10 amperes and 45 volts, the same as is used for arc lighting on a number 6 wire. The smaller candle power lamps use a current of 5 amperes on a number 8 B. and S. wire. The dynamos are wound for the specified current lamps. The wattage of the 25 candle power lamps is 75 watts or three watts to the candle power,—as close an economy of power transformed into light as is obtained by means of the best multiple arc systems. On the larger candle power lamps, such as the 100 candle power, the wattage is even closer, being 2.85 watts per candle power. On the 25 candle power lamps the high efficiency of the dynamos, 94 per cent. enables 9 of these lamps or 225 candle power to be obtained to the horse power at the dynamo pulley, which is a gain of 33 candle power over the regular multiple arc systems where twelve 16 candle power lamps are obtained to the horse power. Arc and incandescent lamps can be used indiscriminately on the same circuit.

The closed circuit form of armature being used, the high static current of open circuit systems is avoided, and the difficulty of keeping the wires insulated is much reduced.

The illustration shows the style of incandescent dynamo manufactured by this company. It has a cast iron foundation pan which besides forming a foundation for the machine to rest on, usually sufficient on ordinary well built floors, acts as a catch for oil, thus avoiding oil grounds to floors of buildings common with dynamos that use oil largely. It also holds the belt adjusting screws. These machines have a very fine finish, and evince very great care and skill in the details of construction, which though more costly in the first instance than a more roughly finished machine, pay in the long run. The headquarters of the company are at Hartford, Conn., at the celebrated Colt's armory; the Chicago office is at 154 LaSalle street.

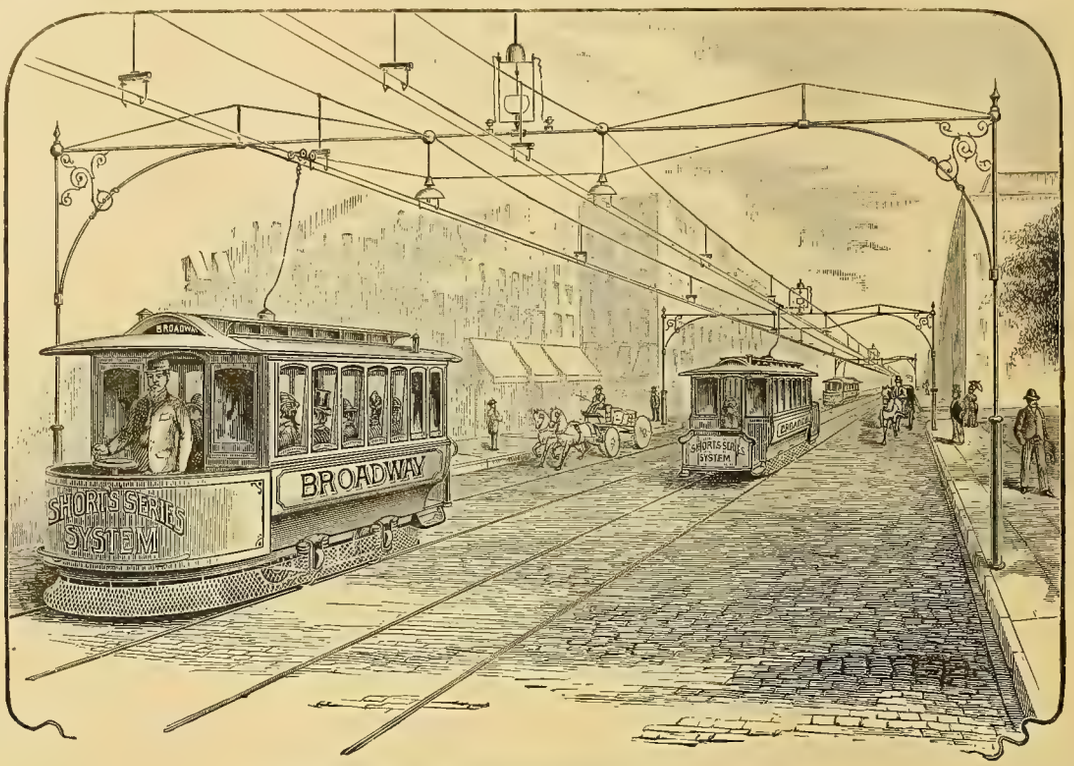
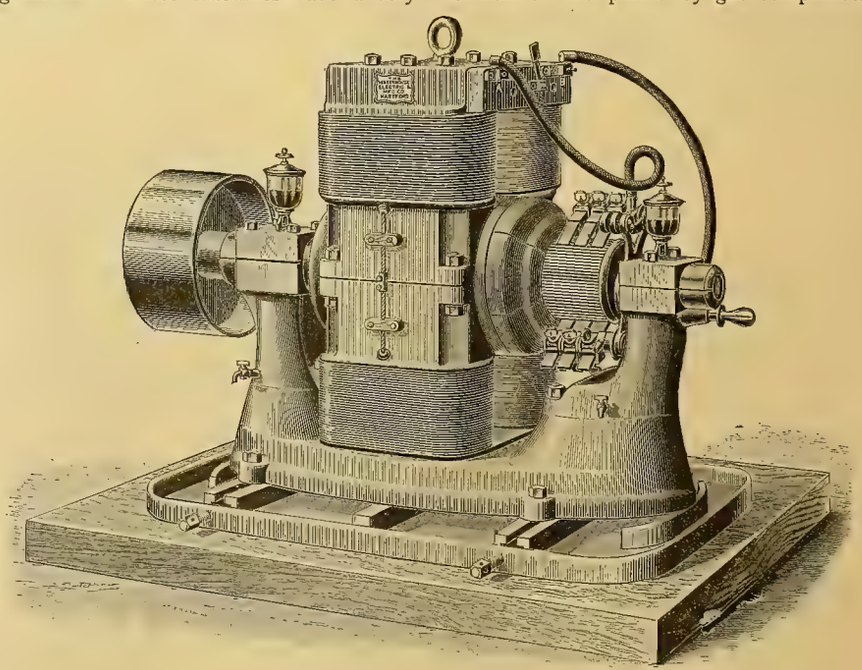


Fig. 6.—The Short Series System of Electrical Railways.



The Waterhouse Incandescent Dynamo.

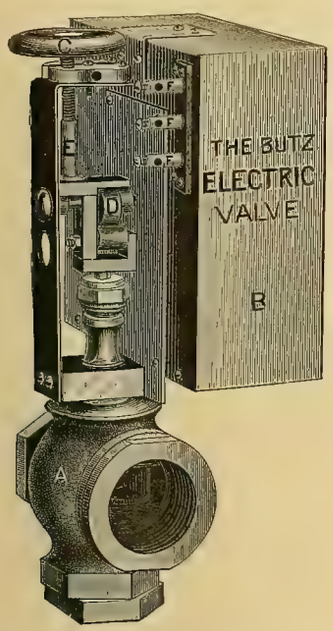
Western Gas Association Annual Meeting.

The eleventh annual meeting of the Western Gas association was held in Chicago last week. There were 150 members in attendance. Fifty-two new members were received. Among the papers presented was one read by C. M. Keller of Columbus, O., on "The cost of arc light." Mr. Keller is secretary and superintendent of the gas company and electric light company in that city. The latter company employs an American dynamo of fifty lights capacity and a Thomson-Houston dynamo of the same capacity. The cost of maintaining an all night arc lamp according to his estimate was 20½ cents per night. The cost of an eleven o'clock lamp was 17½ cents per night. Mr. Keller showed that as the plant was increased the cost per lamp decreased. He favored the plan of the establishment of arc plants by gas companies. He argued that they were in a position to do the work cheaper than any electric lighting company or municipal corporation. The paper provoked quite a little discussion and most of those who participated thought that Mr. Keller's position in reference to the installation of plants by gas companies was well taken.

The subject of fuel gas was one which was discussed with great interest. The members predicted that this was to be one of the most important branches of their work in future.

The banquet took place Thursday evening and was a most enjoyable event. The next convention will be at Cincinnati.

A number of electric light men dropped in to see the visitors and to give them a few gratuitous suggestions concerning improved methods of illumination. As one of the members said those "electric men are the blamedest, most persistent



set of fellows I ever saw. They hang on and they don't think for a minute of letting you go. They have more schemes for lighting a place than a man can think of in a month and their own system is the finest, most reliable thing in the world. They are great on business."

The Butz Thermo-Electric Valve.

The illustration above shows the Butz Thermo-Electric valve which, in connection with a thermostat, is used for the automatic regulation of temperature. This valve does not require any assistance in the way of pneumatic appliances. Three electric wires and two cells of battery in combination with a thermostat make up all that is required to shut off or turn on steam at any pressure for direct or indirect radiation and the perfect regulation of temperature in residences, public buildings, hospitals, school houses, conservatories and the like.

The valve A, can be an angle or straight-way valve. The steam enters the chamber surrounding the core in which the double-seated valve is closed by the stem E and eccentric D and held firmly by both the eccentric and the pressure of the steam, as the upper valve seat is necessarily somewhat larger than the lower. When the temperature falls closing the opening circuit of the thermostat, the motor B revolves the shaft and eccentric D, opening the valve seats, allowing the steam and water to pass in and out freely in case the valve is used on the single pipe system. When the temperature rises above the desired degree closing the closing circuit on the thermostat, the motor B again revolves the shaft D a half revolution tightly closing the valve seats and shuts off the steam.

If for any reason it should be necessary to open or close the valve by hand without the aid of electricity, this can be done by loosening a set screw on eccentric D and resorting to the wheel C to raise or lower the valve stem E.

This valve is manufactured by A. M. Butz & Co., Chicago.

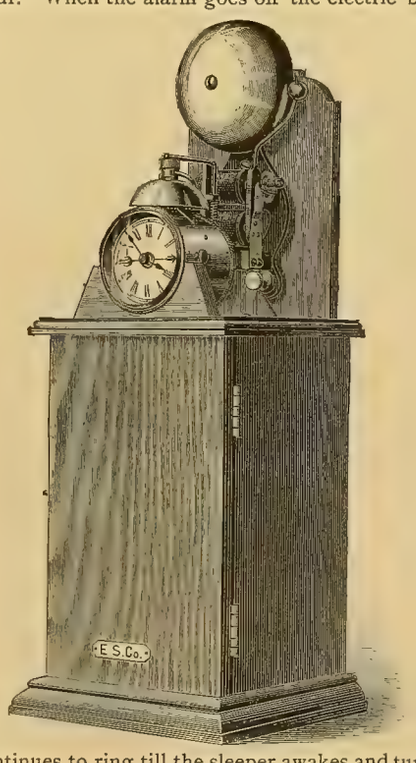
The Electric Light and Astronomical Observations.

"Yes, I have seen several times the statement that the electric lights in Detroit interfere with our astronomical observations here," said Professor Mark W. Harrington, of the University of Michigan at Ann Arbor, in reply to a query from a Detroit *Tribune* correspondent. "I can not conceive how any such statement should be sent broadcast through the country. It is a fact that I have received nearly a dozen letters of inquiry from prominent scientists in as many different states, asking if it were so, and many other questions, since that statement got into print. Now the fact in the case is that the electric lights in Detroit do not interfere with us at all, but instead they have proven a subject of much interesting study for us. When the nights are clear we can not see any reflection from them. Neither can we see them when the clouds are heavy and hang low over the city. But when the clouds are high we can see the reflection of the lights on them. When Professor Schaiberle and myself first discovered what appeared to be a white speck in the eastern sky we were at a loss to know what it was. Of course we knew of the electric lights in Detroit, but we could hardly believe it came from them. It did not seem possible to us that they would throw a light on clouds so high up in the sky as these must be to enable us to see it. I am not going to tell you how high those clouds are from the earth, as you would be hardly ready to believe me, but we are now at work figuring it out and I will be ready to give your readers some interesting facts in relation to this at a future day. You see we know the exact distance from here to Detroit and the exact altitude of the observatory above Detroit, so it will be comparatively easy for us to make our computations.

"Now I know of only one way that the statement could have been made," continued the professor, "and that is by somebody's getting our own electric lights mixed up with those at Detroit. The lights here in the city do bother us once in a while when the clouds are hanging low over the city and there is snow on the ground. Then the reflection from the lights here bother us slightly. But I must say we have been happily disappointed even in this, for we were fearful when the lights were first put in that they were going to interfere with us to such an extent that our observations would be a failure."

Electric Clock.

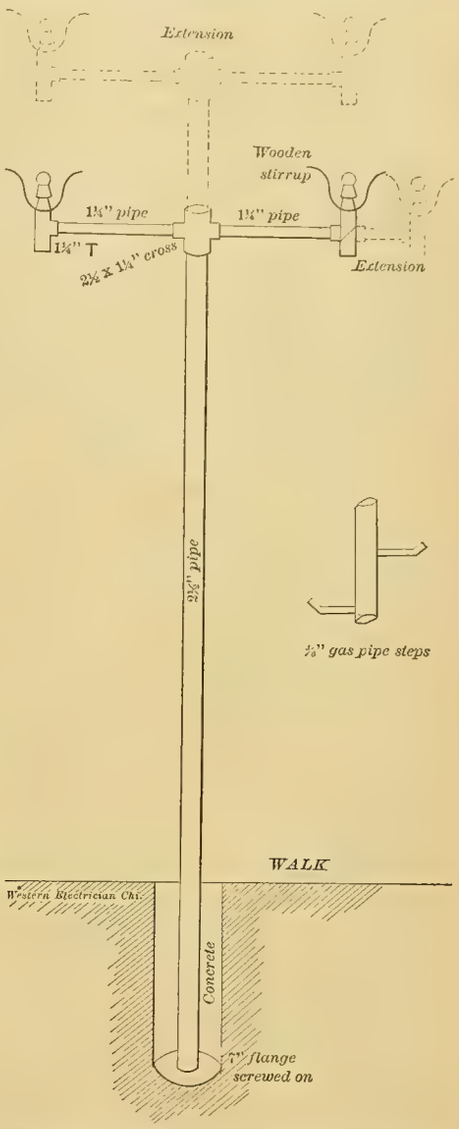
The accompanying cut illustrates a simple contrivance which is a great boon to people who have to rise at an early hour and wish to enjoy sleep till the last minute. The clock is set like any ordinary alarm clock, to ring at any desired hour. When the alarm goes off the electric bell



continues to ring till the sleeper awakes and turns off a switch. The clock is manufactured by the Electrical Supply company of Chicago.

The Sandusky Iron Pole.

On this page is given a sketch of the iron poles introduced into Sandusky, O., and supplied by the Sandusky Electric Light, Fuel, Gas & Supply Co. to other places. The method of setting is as follows: A hole is made in the ground with an ordinary 7-inch post hole auger to a depth of five



feet and the pole with a flange on the bottom, is set in the hole. The space around the pole is filled with cement concrete, and the whole left to stand two or three days to set sufficiently to run the lines. The total length of ordinary line poles is 25 feet, of which five feet is in the ground, the distance to the first arm being 20 feet. The method of increasing the capacity of these poles is a reversal of the ordinary plan as the lowest arm is put on first and as necessity demands, new arms are added on top by screwing in another short piece of pipe and putting arms on the new extension. Thomas Wood, superintendent and secretary of the company writes:

"We have found these poles to be substantial, pleasing to the eye, not obstructive, and free from danger. We have not as yet had a ground on them although we do not use the stirrups shown in the cut.

"If by any reason the current should go to the ground on one of these poles we think that the ground connection is so good that a person standing on the sidewalk and in contact with the same could not receive a very severe shock, as the resistance of the human body would be far in excess of that of an iron pole imbedded five feet in moist earth. The iron pole is, of course, more expensive than cedar of the same size but the additional cost is not much compared to an underground system and in many cases a line of small iron poles would be no objection to the public where cedar poles would not be allowed. We have used our poles now for two years, have had no trouble whatever, and think the danger from their use is more imaginary than real.

"We are busy putting in an incandescent plant, and this reminds me that on these poles I have put two number 1 wires besides the arc wires already on them, so you see they will carry a good weight although only of 2½ inch pipe.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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EASTERN OFFICE, 30 TEMPLE COURT, NEW YORK.

SUBSCRIPTION in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of 4 or more, $2.50, with free extra copy for 8 subscriptions; foreign Countries, $4.00 a year; single copies 10 cents. **Trade supplied by Western News Company.**

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Notice to Subscribers.

Subscriptions to the WESTERN ELECTRICIAN, weekly, at $3 per annum and *The Electrical Engineer*, of New York, monthly, at $3 per annum now filled from this office at $5 per annum for both journals.

THE town of Pullman is to have an electric railroad. Those interested in rapid transit in Chicago will now have an opportunity at their very doors of inspecting the workings of an electrical railroad. The overhead system is to be employed.

A BRIEF report of the meeting of the Western Gas association appears in another column. It is a noticeable fact that in this convention the subject of electric lighting was one of the most interesting topics discussed. This question is forcing itself upon the attention of gas companies and the progressive men have waked up to a sense of its importance.

ST. PAUL rejoices in the possession of an electric road, the only line of the kind in operation in Minnesota. The trial trip was made last week and the complete success of the motor was demonstrated. A public gathering was called to celebrate the completion of the road, at which Minneapolis was largely represented. St. Paul was highly satisfied and self-complacent over the added attraction and its rival city was generous enough to extend very hearty congratulations.

WHEN English electrical journals have nothing else to vent their spite upon they turn toward America and criticize the careless manner in which electric light plants are installed. They speak of English electricians as slow but always reliable. The lights in the Gaiety theater in London were extinguished a few nights ago. It is some satisfaction to note that an American lady, Miss Ada Rehan, of Daly's company, which was playing in the house, prevented a panic by reassuring the audience and the performance was soon resumed.

THE conclusion of the discussion by members of the London Society of Telegraph Engineers and Electricians of the paper of R. E. Crompton, in which he advocated the merits of the battery transformer as opposed to the alternating current transformer, is given in this issue. No little interest has attached to the views expressed both by the author and by those who discussed his propositions. In connection with questions so frequently propounded at the Chicago Electric club relative to alternating current motors, the following remark of Mr. Swinburne is of interest: "The only objection to the use of alternating currents for driving motors was that the motor would have to be very large."

THE United States Supreme court last Monday denied the application made by the People's and Overland Telephone companies for the rehearing of the telephone case. The decision was announced by Judge Miller orally. He said the application would be denied as none of the three judges who had concurred in the opinion of Chief Justice Waite had requested a reopening of the case, and it was the settled rule of the court not to grant rehearings unless such a request was made. This decision is not a surprise. Those interested in the Bell company confidently expected such a decision and it is not unlikely that their opponents shared in the same belief although they may have hoped against hope.

SCARCELY a week passes by without some added proof that the electric light circuits in New York city are in bad condition. The last incident was fortunately unattended by serious result. Two wires fell from their fastenings and dropping on a horse, laid the animal low. The wires lay on the ground for over half an hour "spitting and flashing in the wet," as a New York paper described it. Traffic was suspended. The New York papers are filled with complaints of the wires. Usually an outcry against the wires follows an accident which could hardly be guarded against, even by constant vigilance. But the accidents in New York are becoming so frequent that one is forced to believe that they are not due entirely to the unfortunate combination of unavoidable circumstances.

THE question of life insurance for those in charge of electric lighting apparatus is a matter of no slight concern to a large body of intelligent and skilled engineers. One benevolent insurance company in Chicago has refused insurance to two engineers who have charge of electric light plants. The matter is made the subject of an article in another column. It does not seem that the society in question proposes to maintain its present attitude unless the facts prove that it is justified beyond dispute. As the organization intends to do what is just in the premises, to make an investigation into the merits of the case, any comment on the situation is at the present time perhaps unfair. The decision, however, will be awaited with interest by a great and growing army of engineers.

A CUT and description of Mr. Edison's perfected phonograph will be found on another page of this issue. The instrument is one which naturally excites the most intense interest not only among those skilled in electrical inventions but among all intelligent persons. It is an instrument of such vast possibilities, of such startling novelty and of such practical utility that the achievement of Mr. Edison has awakened a positive enthusiasm which has not been exhibited since the introduction of the telephone. It may be made to serve a thousand totally different purposes, if the predictions of those who have carefully tested it are verified. It may aid the business man throughout the working hours and charms him in his leisure moments. Employed as it can be for both pleasure and business, it may revolutionize life in both these aspects.

PROFESSOR GRAY'S review of the discovery of what is called electricity and its development is alike interesting to both the advanced reader and the beginner. It is clear and concise and, moreover, is couched in terms that must be intelligible even to a child. It will be noted that he indorses the theory that electricity is a mode of motion, not mechanical but molecular motion, not matter but a condition of matter. This theory, in the present stage of scientific thought and investigation, will suffice as well as any other. Meanwhile, through the efforts of the investigator and experimenter in laboratory and workshop — not knowing precisely what electricity is but steadily acquiring new knowledge as to its manifestations and its abilities to serve man — most wonderful advances are being made which, since the time of Queen Elizabeth, to quote the words of the professor, "may be represented by a falling body which moves with a uniformly accelerating motion — slow at first but now moving at a rate that makes one dizzy to contemplate it." And the end is still afar off.

Referring to the uses to which electricity has been put, the professor speaks significantly when he says "and now we are about to teach it to write." He had the telautograph in mind doubtless when he formulated the phrase. He has taught electricity to write and to reproduce exactly what the hand that holds the pen inscribes on the paper. The fact is one that is accomplished and was accomplished a year ago, but the secrets of the machine have been retained in order that the inventor might as far as possible secure the protection of the laws of this and other countries against those who would only too quickly steal and convert them to their own uses.

THE telephone trouble at Rochester, N. Y., has received some attention in these columns, and now it is a pleasure to state that the differences between the Bell Telephone company and the subscribers have been settled, and that business will soon be resumed.

The trouble between the company and subscribers grew out of an announcement on the part of the company of its determination to substitute toll for flat rates. The proposed rates were decidedly objected to by the subscribers, and the outcome was a decision by some seven hundred of the latter that they would hang up their telephones and not take them down again until the Bell company had acceded to terms laid down by the subscribers. The contest, which seems to have been one of seeing which would give in first, has been a long one—just a year and six months—and the Bell Telephone company has granted every demand made by the subscribers, including flat rates, the placing of the wires underground gradually, and has conceded the city's right to abrogate the contract at any time and to appoint an inspector, to be paid by the company, to see that the underground conduits are laid in a proper manner. In addition several other concessions have been made. In fact, the victory appears to be entirely on the side of the subscribers.

The Rochester *Morning Herald* commenting on the matter, says: "The telephone company's officials thought the storm would soon blow over. But they did not understand the temper of our people. Week after week, month after month passed away, and still there was no sign of surrender on either side. At last negotiations looking to a settlement of the difficulty were begun. At first the telephone company's propositions were scarcely worth considering; but at last that corporation became satisfied that if its plant in this city was ever to be worth anything and this profitable field for such a business was ever to be cultivated again, it would have to make a show, at least, of coming to terms with the subscribers. Accordingly, Colonel Parker, one of the ablest, as well as one of the most genial representatives of the American Bell telephone company, of Boston, was dispatched to Rochester to settle the trouble. Naturally and properly he looked after the interests of his company, but he was too intelligent a man not to see that all the reasonable demands of the People's Telephone association would have to be granted, and several months ago the terms finally secured, with a few modifications, were practically offered by him. A number of weeks have been passed with negotiations over these details, but at last the long struggle is ended with a complete victory for the people and the city."

Electricity.[1]

By Prof. Elisha Gray.

About 640 B. C. Thales, one of the seven sages of Greece, made the discovery that amber when excited by friction, had the power to attract light bodies. Amber was called by the Greeks *elektron*, hence the name electricity. For nearly two thousand years no advance was made in the science; when about the middle of the fifteenth century, Queen Elizabeth's physician, William Gilbert, made a series of discoveries that won him the title of the founder of the science. From that time to the present day the advance may be represented by a falling body which moves with a uniformly accelerating motion,—slow at first, but now moving at a rate that makes one dizzy to contemplate it.

He who wishes to keep abreast with the march of this science to-day, must leave the college and go to the work-shop and into the dark corners of private laboratories; for investigators rarely have time to write; so that text books are years behind the science itself. For centuries it was used only in connection with toys to amuse the curious and was not regarded as of any special importance to man. It was looked upon as an untamed animal having his home in the clouds, with a tongue of fire and a body of flame, and the breath of whose nostrils was death. But Franklin lured him with a kite, coaxed him down to earth—put him in a bottle and demonstrated that he could be tamed and made subservient to the will of man; and man has been learning more and more about him ever since. Like some other animals he has heels that cannot be tampered with—with impunity; but if properly harnessed, and rightly managed he becomes one of the most useful of servants.

Those of us who are just crossing the meridian of life can well remember the first telegraph wire that was strung in this country. To-day it is difficult to find a corner of the earth so remote as to be out of sight of one. You will find them even in the bottom of the seas and oceans. The last twenty years have seen more advance in the science of electricity than all the 6,000 historic years preceding. More is discovered in one day now, than in a thousand years of the middle ages, so that literally, "a day is a thousand years." We put it to all sorts of uses. We make it carry our messages, drive our engine, ring our door bell and scare the burglar.

We take it as a medicine, light our gas, see by it, hear from it, talk with it, and now we are beginning to teach it to write. If Job lived in this age and the question were put to him as of old, "Canst thou send lightnings, that they may go and say unto thee, 'here we are?'" he could say, "yes," and they can be made to say it in the vernacular. A friend of mine says in verse:

Time was when one must hold his ear
Close to a whispering voice to hear;
Like deaf men, nigh and nigher;
But now from town to town he talks
And puts his nose into a box
And whispers through a wire.

In olden times along the street
A glimmering lantern led our feet
When on a midnight stroll;
But now we snatch when night comes nigh,
A piece of lightning from the sky
And stick it on a pole.

The question naturally arises in contemplating this subject, "What is it?" I can imagine the last man on the last day asking this same question—"*What is it?*" At one time, not long ago, it was supposed to be a fluid, by some two fluids, a positive and a negative. But in this day there are few who do not believe it to be simply a mode of motion; not matter but a condition of matter; and not a mechanical, but a molecular motion. By mechanical motion is meant a motion of the mass, and by molecular motion is meant a motion of the ultimate particles, of which the mass is made up.

This is based upon the theory that all forms of matter are made up from a number of ultimate particles that are indivisible; that each ultimate element has its unit called the atom and that each compound has its unit called a molecule and is made up of two or more atoms combined according to the law of chemical affinity. According to this theory, the atoms and molecules do not actually touch each other but are held together by an attraction in a sense like gravitation, and yet not like it. The attraction that holds the atoms of a molecule together is called chemical affinity or chemism. The attraction that holds one molecule to another in a mass of matter is called the attraction of cohesion. Now if all these atoms have an independent motion they must have room to move in. It must have space, and here we get into trouble again—for what is space? It is held that really there is no such thing as actual space in the sense of an absolute vacuum, but that all the atoms that go to make up all the matter of the universe are afloat in a highly elastic fluid called ether. This is difficult to conceive but more difficult to get along without. If you ask how the ether is constituted I answer as another did who disputed the rotundity of the earth. He insisted that it was not suspended in the air but rested on a great rock. When pressed to know what the rock rested on he said, "don't ask such questions, you will strain my philosophy."

Having found a very ethereal foundation to start with, we will go on. Some substances are held so slightly by the attraction of cohesion that the molecules revolve freely about each other. Such are the fluids and gases. When we heat a piece of metal—or strictly when we make it hotter than normally, for it always has more or less heat—we simply cause the already vibrating molecules to swing with a greater amplitude. To do this the molecule must have more room so they all move a little farther from each other, hence the phenomenon of expansion by heat. When it is cooled it goes back to the size that belongs to whatever the temperature is. If this expansion is carried beyond a certain point the attraction of cohesion is partly overcome and the metal melts and becomes a fluid. If this is carried still farther it may be pushed into vapor. So much for heat. Electricity is a twin brother of heat. It is a motion of the molecules or atoms, but a motion of a peculiar form. Some claim that heat motion is circular and electrical motion in lines. But the fact that they are interconvertible is strong proof of their twinship. It is called one of the forces. I should say there is but one force, and that this one force takes on different forms under different circumstances.

We have to deal to-night with the action of electricity upon the molecules of air. Air in its normal state is a very good insulator, and it requires a current of high electromotive force or pressure to force it through even a small space of air. But if we go upon a high mountain where the air is rarefied and where we are in a partial vacuum—so called—it will pass more freely and at a certain degree of rarefaction it will pass quite freely. But if we come too close to a vacuum it begins to offer more resistance to its passage until in a perfect vacuum it will not pass at all. If we put a vessel under an air pump and begin to exhaust the air, we thin it, that is we separate the molecules of which it is made up farther from each other and increase the distance that each molecule can move without striking its neighbor. Now it would seem from the fact that electricity will readily pass through air and other gases under a certain state of pressure, and not under another, that the difference between what are called conductors and non-conductors, was purely a molecular difference—the peculiar relation that the molecules occupy one to another. Air under pressure can not easily assume that molecular motion which attends the phenomenon of an electric current, so called. In order to study the effects of an electric current upon air, and other gases, under different conditions of pressure, glass tubes have been constructed with sealed ends, and platinum wires sealed in, so that one end is inside and the other outside of the tube. To these we attach the wires leading from the poles of the electric generator—which must be one of high electromotive force. Before the tubes are sealed the air is partly exhausted. Those called Geisler tubes are low vacua, and when the current is turned on, if nothing but common rarefied air is in it, the effect as to color and movement is similar to that of the aurora, and in fact is the same thing. Long after the Geisler tubes were known, and within the last decade, Prof. Crookes made a series of experiments, in high vacua, with remarkable results. It is this class of tubes that we shall show you to-night. These tubes are exhausted to about one-millionth of an atmosphere. An atmosphere is the unit of air pressure; and it represents the weight of a column of air at the sea level of one inch square extending to its full height. This is found to be fifteen pounds, so that one-millionth of an atmosphere is one-millionth of fifteen pounds.

When the tubes are thus exhausted there are comparatively so few molecules of air left, only ten billions to the cubic inch, or only one-millionth of the normal number; that most of them can be projected the entire length of the tube without striking other molecules. The action is this: When the current is turned on the molecules are violently thrown from the negative pole at right angles with the surface of the electrode. If the electrode were a sphere the radiant matter would be thrown in all directions. They fly in straight lines until they strike something that arrests their progress—whence they go to the other pole, deliver up their charge and go back and are fired off again.

If the negative electrode is concave the radiant matter is made to come to a focus, just as rays of light converge. Prof. Crookes has succeeded in thus melting iridium, platinum and glass by simple molecular bombardment. This proves that there is weight in the molecule, and also that they are thrown with a velocity inconceivably great to produce such powerful heating effects—taking into account the fact of the extreme smallness of the projectile—so small that fifty million of them can go to bed on a line of one inch in length and one 50-millionth of an inch in breadth.

When these missiles strike the sides of the tube they produce the phenomena of phosphorescence, which in this case is only the self-luminous quality of the glass under great molecular stress. It is electricity excited in the glass on the principle of friction. Uranium glass can be rendered luminous by simply rubbing it. If mercury is put in a glass tube, and the air exhausted it will become luminous by shaking, even in the slightest degree. The friction which in air at normal pressure produces heat only, with the pressure off produces first electricity, and then changes into heat. Different substances phosphoresce in different colors. When the air particles simply bombard each other in a common Geisler tube of low vacuum they phosphoresce a pinkish purple color. This same thing is going on in the northern sky when an aurora is in progress. Ordinary glass phosphoresces a yellow green—but different colors are brought out by different qualities of glass—as will be seen in a few moments.

[1] Lecture preceding a series of experiments conducted by Prof. Gray at Ferry Hall, Evanston, May 10th.

Battery and Alternating Current Transformers.

The discussion of the paper of R. E. Crompton on the "Battery transformer *vs.* the Alternating Current transformers," was resumed at a special meeting of the London Society of Telegraph Engineers and Electricians, April 19th. Mr. Preece mentioned three arguments in favor of the battery: The convenience of storage, the utilization of the current for motor purposes, and the fact that a small plant could be used during the whole of the day. He said there were also several arguments in favor of transformers: A higher e.m f. can be employed, and therefore a smaller current in the distributing mains; that transformers are simple in construction and can be easily stored away in odd corners or, as Mr. Kapp suggested, below the pavement, and that no supervision is required, and that the efficiency of transformers is undoubtedly much higher than that of batteries. With reference to the load diagrams for electric lighting during the twenty-four hours, he said it was necessary, in any case, to provide energy for the period corresponding to the high points of the diagram, and that it did not matter much whether the capital was expended in the purchase of more batteries, or in providing additional engine power. Electric lighting on the transformer system had been successfully carried out by Messrs. Gaulard and Gibbs at the Grosvenor Gallery installation, which had been a pioneer for electric lighting in England. The transformer system had also been used with favorable results to a still greater extent in the United States. With reference to Mr. Crompton's remarks as to the waste of steam in the secondary generator system, he considered this to be a question which related to the engineering principle adopted, rather than to the question whether transformers or accumulators should be used. The loss took place in the engine room and not in transforming. An important question, not raised by Mr. Crompton in his paper, was whether 30-watt 10 candle power lamps or 60-watt 16 candle power lamps should be employed. He himself was in favor of the smaller candle power lamps, which gave satisfaction in all cases where the others had not been previously supplied.

Another question which should be considered was with regard to the best voltage to be employed. In England, all kinds of potential differences were used indiscriminately in different installations; but he thought there should be uniformity. In America 50 volts had been generally adopted, and the lamp had a longer life, as the filament was thicker. In respect to the relative economy of transformers and accumulators, consulting engineers had to base their advices on the nature of the district proposed to be lighted. A compact neighborhood such as the city of London could best be served by the Hopkinson-Edison three-wire system; but this would not be the case with a scattered district like Wimbledon, where the mains may be ten or twelve miles long. While he was interested in secondary batteries he would give his opinion in favor of the secondary generator.

Sir David Salomons agreed with the figures relative to the cost of lighting by means of transformers, which Mr. Crompton had given. The efficiency of accumulators might fairly be estimated at about 70 per cent., and the durability was greater than generally supposed. With regard to the paste falling, his experience indicated that there was not more than 1 lb. lost after three or four years' use. He thought the 4 per cent. margin of potential difference allowed by Mr. Crompton much too high, and that 2 per cent. was more than enough unless the lamps were overworked. The working of central stations without accumulators was much the same as having gas works without a gasometer. At the same time he believed that the first installation would not see a return of sixpence. In the load diagrams given by Mr. Crompton the curve would become more regular, as electromotors are certain to come into extensive use. To avoid the possibility of a breakdown, accumulators should be arranged with two or more sets in parallel. In his own experience there had been a case where, if one series only had been used, a breakdown would have resulted. He agreed with Mr. Kapp that it was very important to have an efficient system of regulation, a point which had not been mentioned by Mr. Crompton. Old accumulator cells could be renovated and made practically equal to new at the expense of about 1 per cent. of their original cost.

Mr. Crompton explained his method of regulation by attaching the leads to intermediate cells in each series, allowing the current to pass simply through the outside cells in parallel, without any energy being taken from them. A simple mechanical arrangement was used for adjustment, which was at present performed by hand, and which could easily be rendered automatic if desired.

Mr. Swinburne referred to the practicability of employing alternating current machines in parallel, and stated that it all depended upon the kind of machine employed. He described a method which he had devised for automatically stopping machines which get out of step. The only objection to the use of alternating currents for driving motors was that the motor would have to be very large. Alternate current machines could be made to run at low speeds, and cheaper than direct current machines.

General Webber criticised Mr. Crompton's proposal to lay down bare copper conductors, suspended by insulators from the roofs of subways, with a cross section of two superficial feet. Such subways could not be made water tight. At first there would not be much difficulty; but within a couple of years the conductors and insulation would be completely destroyed, as the subways would leak, and would also very soon be tenanted by rats. The conductor could not be got at without taking up the roadway. He pointed out that no difficulty had been experienced in raising capital for the London Hydraulic company, whose system was a far more costly means of distributing energy than by means of electricity, and he expected that there would be a large increase in the demand for electrical distribution of energy. Mr. Crompton's allowance of 20 yards of main lead for each house was excessive, 17 yards being amply sufficient in the case of a district with wide streets and long frontages. The use of bitumen concrete casing for underground conductors was, from his own experience, found to be very satisfactory, and could be employed in the city, where such a subway as Mr. Crompton's could not be laid down.

Sidney Walker pointed out that the apparatus to which they must look for progress, more than either to transformers or batteries, was the lamp, as a 200-volt lamp would greatly reduce the cost of copper. A cheap and more efficient lamp would largely assist in the development of central station lighting. The increased cost of providing durable insulation for dynamos and for mains with high potential currents, more than counterbalanced the advantages attending the use of transformers; and an absolutely efficient service could be obtained with accumulators.

Mr. Hammond vigorously repudiated Mr. Crompton's statement that the Brighton and Eastbourne installations were only of a temporary character. The installation at Eastbourne had been running for six or seven years, and the distribution there was not by means of overhead wires, as had been stated. At present they had to be contented with doing scattered lighting, and the transformer system was found to be undoubtedly the most suitable, and there was no difficulty in having the load just proportionate to the current required. With regard to the theory that the battery system was preferable because of its reserve of force, the same was the case in the transformer system, as a spare engine was always in readiness in case of a breakdown, and an engine was hardly likely to suddenly stop without warning. He had some accumulators in use at Brighton, and these formed the only portion of the system of which they were at all afraid. They were by no means equal to the theoretical efficiency, as only 60 per cent. could be obtained, while their Eastbourne transformers gave an efficiency of 95 per cent. He considered ten per cent. far too high an allowance for the depreciation of transformers which were of very simple construction, and had no moving parts; in fact, such an allowance was even too high for dynamos. On the other hand, Mr. Crompton's allowance of 15 per cent. for depreciation of accumulators was too low

Mr Trotter thought that until makers of accumulators were prepared to guarantee to keep them in order for a fixed annual payment few persons would care to risk the expense. He considered Mr. Crompton's assumption that two houses out of three would require the electric light was too sanguine for some years to come, and that two out of ten was a much more reasonable estimate, and this told greatly in favor of the use of transformers. Some prejudice had been caused owing to the want of a spare engine at full load, and the example of water works should be followed, which always had a reserve of power in case of accident.

London Fire Regulations.

The Society of Telegraph Engineers and Electricians has recommended the adoption of the following rules for the prevention of fires from electric lighting:

These general rules are drawn up with the object of reducing to a minimum, in the case of the electric light, those risks of fire, which are inherent to every system of artificial illumination, and also for the guidance of those who possess, and those who contemplate having, electric lighting apparatus on their premises.

It is to be understood that these general rules are not intended to supersede any detailed rules which fire offices may issue for their own protection.

It would therefore be desirable that before the electric light is used, notice should be sent to the fire office in which the building is insured, in order that an opportunity may be given for inspecting the installation.

The chief difficulties which beset the electrical engineer are internal and invisible, and they can only be effectually guarded against by testing with special apparatus and electric currents; they arise from leakage and from bad connections and joints, which lead to waste of energy and the production of heat to a dangerous extent.

In addition, the difficulties arising out of defective and inefficient apparatus are numerous; they must be understood and guarded against.

The necessity can not be too strongly urged for guarding against the presence of moisture, which leads to loss of current and to the destruction of the conductors and apparatus by corrosion and otherwise.

Injudicious connections of any part of the circuit with the "earth" tend to magnify every other source of difficulty and danger.

Many of the dangers in the application of electricity arise from ignorance and inexperience on the part of those who supply and fit up inadequate plant, and frequently from injudicious economy on the part of the user.

The greatest element of safety is, therefore, the employment of skilled and experienced electrical engineers to specify the method in which the work is to be done and the quality of the materials to be employed, and to supervise the execution of the work.

Conductors.

1. They must have a sectional area and conductivity so proportioned to the work they have to do that, if double the current proposed is sent through them, the temperature of such conductors shall not exceed 150° F.

2. The conductors, or their casings, should be placed in sight, if possible; and they should always be as accessible as circumstances will permit.

3. Within building they should all be insulated; and this rule applies equally to all conductors and parts of fittings which may have to be handled.

4. Whatever insulating material is employed, should not soften until a temperature of 170° F. has been reached, and in all cases the material must be damp-proof.

5. When leads pass through roofs, floors, walls, or partitions, and where they cross or are liable to touch metallic substances, such as bell wires, iron girders, or pipes, they should be thoroughly protected by suitable additional covering; and where they are liable to abrasion from any cause, or to the depredations of rats or mice, they should be encased in some suitable hard material.

6. In the case of portable fittings with which flexible leads are used, special precautions must be taken.

7. Conductors should be kept as far apart as circumstances will permit the spacing between them being governed by their potential difference.

8. When conductors are carried in very inflammable structures, precautions should be taken to isolate them therefrom.

9. Conductors which are protected on the outside by lead, or metallic armor of any kind, require the greatest care in fixing, on account of the large conducting surface which would become connected to the core in the event of metallic contact between them.

10. In cases where conductors pass into a building, from one building to another, or from one room to another, precautions should be taken to prevent the possibility of fire or water passing along the course of the conductors.

11. All joints must be mechanically and electrically perfect, to prevent heat from being generated at these points. When soldering fluids are used in making joints, the latter should be carefully washed and dried before insulation is applied.

12. Under all circumstances complete metallic circuits must be employed. Gas and water pipes must never form part of the circuit, as their joints are rarely electrically good, and therefore become a source of danger.

13. Overhead conductors, whether passing over or attached to buildings, must be insulated at their points of support. Precautions must be taken to obviate all risk of short-circuiting where they are likely to touch a building or other overhead conductors and wires, either by their own falling or being fallen upon by other conductors.

14. In the case of overhead wires, every main should have a lightning protector at each point where it enters or branches into a building.

15. Metal fastenings for fixing conductors should be avoided; but, when unavoidable, some additional covering should protect the conductor from mechanical injury at such fixing points.

16. The insulation of a system of distribution should be such that the greatest leakage from any conductor to earth (and, in case of parallel working, from one conductor to the other, when all branches are switched on, but the lamps, motors, etc., removed), does not exceed one five-thousandth part of the total current intended for the supply of the said lamps, motors, etc.; the test being made at the usual working electromotive force.

17. It will often be found a great convenience and assistance in the prevention of accidents if the positive lead be colored differently to the negative, or made otherwise distinguishable.

Switches.

18. Every switch or commutator should be of such construction as to comply with the following condition, namely — That, when the handle is moved or turned to and from the positions of "on" and "off," it is impossible for it to remain in any intermediate position, or to permit of a permanent arc, or heating.

19. The handles of every switch must be completely insulated from the circuit.

20. The main switches of a building should be placed as near as possible to the point of entrance of the conductors, or to the generators of the current if they are within the building itself. Switches should be provided on both leads.

21. Switch-boards should bear clear instructions for their use by the inexperienced.

Electrical Fittings Generally.

22. Switches, commutators, resistances, bare connections, lamps, etc., must be mounted on incombustible bases. Cut-outs mounted on bases of wood rendered uninflammable are admissible Vulcanite bases are undesirable in damp situations. The cracking of porcelain and earthenware fittings is a source of danger which can be avoided by precautions in fixing.

Cut Outs.

23. All circuits should be protected with cut-outs; and all leads from the mains, or small conductors from larger ones, must be fitted with cut-outs at their branching points.

24. Where fusible cut-outs are used the section should be so situated within its frame that the fused metal cannot fall where it may cause a "short circuit," or an ignition.

25. For all main conductors a cut-out should be provided for both the "flow" and "return,"

and the two fusible sections must not be in the same compartment.

26. The flexible leads of portable fittings must in all cases be protected by cut-outs at their fixed points of connection.

ARC LAMPS.

27. Arc lamps must always be guarded by lanterns or netted globes, so as to prevent the danger from ascending sparks and from falling glass and incandescent pieces of carbon.

28. All parts of the lamps and lanterns which are liable to be handled (except by the persons employed to trim them) should be insulated.

THE DYNAMO.

29. The armatures and field-magnet coils should be thoroughly insulated. Dynamos should always be fixed in dry places, and they must not be exposed to dust flyings or other industrial waste products carried in suspension in the air. They should not be permitted in the working rooms of mills, where the liability to such danger exists, or where any inflammable manufactures are carried on or inflammable materials are stored.

30. Motors should be subject to the same conditions; but when it is necessary to use them in positions such as those above referred to they must be securely cased in, such cases having a non-combustible lining.

BATTERIES

21. Both primary and secondary batteries should be placed and used under the same precautions as prescribed for dynamos; and the room in which they are placed should be well ventilated. The batteries themselves must be well insulated.

TRANSFORMERS.

32. When these are used to transform either direct or alternating currents of high electromotive force—that is, from or to an electromotive force of, say, 2000 volts—they, together with their switches and cut-outs, must be placed in a fire and moisture-proof structure—preferably outside the building for which they are required. No part of such apparatus should be accessible except to the person in charge of their maintenance.

33. In all cases conductors conveying currents of high electromotive force inside buildings must be specially and exceptionally insulated, cased in, and the casing made fire-proof.

34. The positive and negative terminals connected to such conductors should not be permitted to be nearer each other than 12 inches.

35. Transformers which, under normal conditions of load, heat above 150° F., should not be permitted to remain in use.

36. Transformers should be so constructed that under no circumstances whatever should a contact between the primary and secondary coils lead the high e. m. f. into the building.

MAINTENANCE.

37. The value of frequently testing and inspecting the apparatus and circuits cannot be too strongly urged as a precaution against fire. Records should be kept of all tests, so that any gradual deterioration of the system may be detected.

38. Cleanliness of all parts of the apparatus and fittings is essential to good maintenance.

39. No repairs or alterations must be made when the current is "on."

All the above rules, for the reduction to a minimum of the risks from fire, are also applicable in principle to installations of electricity for other uses than that of lighting; they also include precautions necessary to avoid risk of injury to persons, whether the conductors and apparatus are situated inside or outside a building.

The 2,200 wires formerly running into "two" and "five" office were transferred into the new telephone headquarters of the Chicago Telephone company, corner of Washington and Franklin streets, last week. The new system is so perfect that the transfers were made without breaking the connections for more than ten minutes on any of the multitudinous wires. The work began shortly before midnight and was completed at about 5 o'clock the following morning. The new plant is claimed to be one of the most perfect ever constructed. Each operator has control over the wire of every subscriber in the entire system, and can make a connection without calling upon a second operator. This obviates the necessity of repeating a call an indefinite number of times to a corps of telephone girls.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 12.—The proceedings of the Board of Electrical Control have been very much enlivened since Mayor Hewitt was added to it as a member ex-officio. At the very outset he "he took the bit in his teeth" and apparently made an attempt to run the whole business. Every effort was made to accommodate him and the meetings have since been held in his office for his sole convenience. He has not been able to disguise his contempt for the work of the board, although his sarcastic remarks, and outbursts of passion have in the main been directed toward young Mr. Gibbens. Although Mr. Gibbens makes no pretentions toward electrical knowledge, he is not too old to learn, as the mayor admitted to be his own case. On Thursday the storm broke, and Mr. Gibbens openly accused the mayor of actually obstructing the work of burying the wires, which was in consequence a year behindhand. It certainly appears that his honor had no valid defense to the charge, and he pettishly withdrew from the meeting and the board, while his colleagues and the reporters listened to a passionate denunciation of the mayor and all his works, from the lips of Mr. Gibbens, who delivered his oration in true forensic style. The proceedings wound up with a decision to meet hereafter at the office of the board, 1218 Broadway.

Another man was killed by the current from a Brush wire, on Friday morning. It was a rainy day, and Lineman Thomas H Murray had been sent to look up an escape on one of the circuits. In pursuance of this duty he went out of a second story window of 616 Broadway to examine a loop which terminated at the insulators on a sign, the arc lamp formerly in use at the place having been discontinued. What followed is unknown, excepting that his lifeless body was discovered a few moments later, hanging over the sign. It is evident that he failed to exercise proper precaution, yet it is another life lost by electricity and as such will be used as an argument in favor of doing "something" to prevent such casualties.

Mr. Edison gave a private exhibition of his perfected phonograph yesterday at his laboratory in Orange, N. J. It worked satisfactorily and is announced for exhibition this evening at the Electric club. Articles of incorporation of the Edison Phonograph Manufacturing company were filed in New Jersey last week. The company has a paid up capital of $300,000 and its incorporators are Thomas A. Edison and Alfred S. Tate of Orange; Charles Batchelor and John L. Tomlinson of New York.

The Board of Police commissioners is still engaged in an internal wrangle regarding the merits of the Herzog teleseme system. In reply to the criticisms of Commissioner Voorhis, that it is unsuitable for police work, General Fitz-John Porter states that practical tests were made with the apparatus and that in his presence policemen were easily instructed in its use in a very few minutes. He believes that the noises of the street would interfere with the satisfactory working of telephones, which is possibly an intimation that on account of the quietness prevailing in Chicago, Philadelphia and elsewhere a system which would answer in those places would not suit the metropolis.

Two young ladies of South Chester, Pa., went into a store where there was a galvanic battery, and the proprietor asked them to try it. Each grasped a pole of the battery, and wondered why no shock was felt. The proprietor suggested that they kiss each other. They did so, and then there was a shock indeed. One of the young women shrieked and fell over backward. The other made no sound, but fainted. Cold water brought them both around none the worse for the kiss.

A very important line of patents was issued May 1st to Nikola Tesla, covering a practically new system of alternate current motors and transformers. He will read a paper on the subject before the general meeting of the Institute of Electrical Engineers on Wednesday, and those who desire to do so will be given an opportunity to inspect the apparatus under working conditions at 89 Liberty street.

Two fires have been caused recently by electric light wires, one at the Lotus Club, and the other at 749 Broadway upon the premises occupied by the *American Magazine*. In both cases the fire broke out in the ceiling. In the Lotus club the trouble appears to have been caused by defective insulation. It is evident that our insurance regulations need revision.

The Manhattan Elevated railway company, has not abandoned the hope of using electric motors on its lines. The Sprague company is about to place one of its cars on the Ninth avenue track. It is now being built at the works of the Gilbert Car manufacturing company of Troy, N. Y., and is similar in in appearance to the cars now used on the Brooklyn Bridge, having doors in the center as well as the ends. It is 46 feet long and has eight 42-inch wheels. The motor is expected to be able to pull four cars at the rate of 25 miles per hour. P.

Kansas City News.

KANSAS CITY, MO., May 12.—Much trouble has been caused to the cable railway companies by broken strands in the cable causing serious damage and loss of life. This has been overcome by an attachment invented by C. S. Gilbert of this city. This appliance is so arranged and placed on the massive machinery in the power house that, if a broken strand runs in the house, at once it alarms the engineer through the medium of an electric bell so that he may stop the cable before it leaves the power house and have it repaired.

The Missouri and Kansas Telephone company at its last meeting declared a dividend of 1½ per cent.

The fire that destroyed the building occupied by E. E. Menges & Co. and the Graham Paper company on Delaware street, made things very warm and exciting for the M. & K. Telephone company and the Thomson-Houston Electric Light company whose offices are in the adjoining buildings. Very little damage is reported by the telephone company to their cables and wires which in this locality are very thick.

The Metropolitan Cable company who lately put in the Ft. Wayne Jenney system have already found it necessary to increase their plant and have accordingly ordered additional lamps.

The Rich Hill Electric Light company has changed hands and is now controlled by Messrs. Beamer and Chisnell. They are now running upwards of 40 arc lights and are soon to increase their plant.

The Inter-State Electric company expects to have their accumulator plant at Missouri Valley, Iowa, within thirty days.

The Kansas City Electrical works have received the contract for wiring the Y. M. C. A. building for incandescent electric lights, also a contract for a complete system of call bells and speaking tubes; the work will be under the direct supervision of Mr. Woodring the superintendent of the company.

The Western Engineering and Electrical company of Kansas, under the supervision of C. A. E. Rueble is about to reconstruct the electric light plant at Lawrence, Kansas.

The Union Railway company at St. Joseph, Mo., will extend their lines and will have them in operation as far as the City Hall by June 1st.

A city election was held in Booneville, Mo., on the eighth of this month, to determine whether the city would use electric lights or not. The question at issue, that of granting C. B. Rhodes the privilege of putting in the plant and pledging the city to use it for ten years, was carried by an overwhelming majority of the votes cast. A very light vote was polled, there seeming to be no doubt but that the proposition would carry; 377 votes were cast in its favor and 59 against, a plurality of 318. Mr. Rhodes says he will begin putting in his plant at once and will use the Sperry system of arc lights and the Swan system of incandescent lights. D.

St. Louis Wants Electric Street Lighting.

ST. LOUIS, MO., May 12.—The special committee appointed by the council to investigate as to the cheapest and best way of lighting the city have decided to recommend the passage of an ordinance authorizing the proper committee to advertise for bids for the erection of a complete electric plant for street lighting. They also recommend the asking of bids for a gas plant for the city's use. This is a move in the right direction as the city does not use a single electric light.

The Western Union Telegraph company have been busy for the past few days getting their wires ready for the democratic convention which will meet in the exposition building in June. While the work of stringing the two twenty conductor cables was in progress the Western Union Telegraph company's Locust street pole line was a scene of considerable activity. These cables connect the exposition building with the main office of the Western Union at the corner of Third and Olive streets.

The St. Louis Illuminating company have secured the contract for lighting the north nave of the exposition during the Sængerfest and the democratic convention. They propose to use 800, 30-candle power incandescent lights. The dynamos will be placed in the building, and will be driven by a 12″x18″ Russell engine. This company will run its lamps in series, two circuits from each machine.

There is considerable activity in motor circles. There are about 60 motors in use, ranging from ½ to 15 horse power. The motors are run on arc circuits and on special

power circuits. The motors are giving satisfaction in every instance.

The St. Louis Illuminating company has increased its plant by the addition of a 14x20 double valve automatic engine.

The Davis Carbon company have just commenced to fill orders for carbons.

The electric light plant in the Mercantile library will be, when completed, one of the finest plants in the country. It will consist of three 75 horse power Russell engines, three 30-light Excelsior dynamos and two 700-light incandescent dynamos. The building has been wired throughout with okonite wire by J. F. Porter. The engineer will have full charge. The plant will be in operation 18 hours per day. B.

Indianapolis Items.

INDIANAPOLIS, May 12.— Only three electric light companies responded to the city's advertisement for bids for lighting the city,—the Thomson-Houston, of Boston, the Fort Wayne Jenney company, and the Indianapolis Brush company. Each bid was accompanied by a $5,000 check, called for in the specification as evidence of good faith. From the fact that three companies bidding based their figures on specifications as prepared by the city engineer, it is evident he was not calling for anything impossible as claimed by two or three companies. The specifications called for three classes of bids: 2,500, 2,740 and 3,750 hours lighting per year, each company bidding on number of lights it deemed necessary to light the city as well or better than by the present illuminant gas. The Thomson-Houston bid for the number of hours respectively is as follows: 500 lights, $87 each, $43,500; $90 each, $45,000; $95 each, $47,500. Brush—550 lights, $95 each, $52,250; $101.38 each, $55,759; $116.25 each, $63,995.50.

The Jenney company presents two bids, one for 455 arc, 100 incandescent (for alley lights) $46,500, $50,000, $60,000; also lights without limit as to number, $54,000, $57,500, $67,500. Each company promises to put in a first-class plant in case the contract is given it. Each company also makes a proposition to turn its plant over to the city in a certain time under conditions named in the proposal. The Thomson-Houston company agrees to turn its plant over to the city at the end of three years, provided the city pay it $75,000 a year and furnishes ground free for buildings and grants free use of streets, or in four years at $65,000 a year, five years at $60,000 per year. The Jenney company will turn plant over to city at expiration of a three years' contract at $75,000. The Brush company will turn plant over to city at the expiration of its contract for a price to be agreed on by three appraisers, one to be chosen by the city, one by the company, the third by the other two. The bids are considerably lower than the city now pays for gas.

The Jenney Electric company of this city did not bid.

A gentleman, signing himself a civil engineer, has been carding the papers, since bids were published, endeavoring to show that the city couldn't be lighted by the number of lights given in bids. He bases his calculation on the lighting power of a 2,000 candle lamp the effective radius of which will not exceed 200 feet; at this rate it will take in neighborhood of 1,200 lamps. It is hardly probable companies of the standing of those bidding would undertake an impossibility. The bids were submitted to a committee of three, and the city attorney and city engineer were instructed to make a trip to points using lights of the bidding companies and investigate.

From present indications it is evident the citizens are in earnest in the matter of a new light for the city and the bids seem to have given satisfaction.

Brainard Rorison, of the Indianapolis Jenney Electric company, has gone to California on business of the company. M.

Stillwater's Illumination.

STILLWATER, Minn., May 12.—For a town of its size, Stillwater, the Bluff city, is probably as well supplied with electric lights as any city in the country. Two independent companies are competing for the lighting business, which makes the rivalry quite spirited although entirely friendly. The older company is the Stillwater Gas company, which has been operating for the past five years with about 75 arc lights of the Excelsior system. During the past winter this company built a new station and added to its capacity a 650 incandescent light outfit of the Westinghouse alternating current type. The Gas company is doing commercial lighting exclusively, and is receiving good support from the business men of the city.

The Stillwater Electric Light company is the title of the younger aspirant for electric lighting patronage, and is held in high esteem by the community generally. M. J. O'Donnell is electrician and superintendent. The company operates apparatus of the United States company's manufacture, consisting of a 600 light multiple series, and a 500 light alternating current outfit. The multiple series system is used for lighting the streets of the city, in which service about 225 lamps of 25 candle power each are used. These lamps are located at street intersections throughout the entire city, making an area illuminated by that means of about four square miles in extent. Gas and oil street lights are entirely superseded by the incandescent system, and the results achieved are highly satisfactory to the residents of Stillwater. The street lighting service utilizes about half of the capacity of the multiple series dynamo, and the balance is employed in store lighting. The new alternating current dynamos of the United States company's manufacture has only recently been started, and is performing in a highly satisfactory manner. It is already loaded to over half of its capacity, doing regular commercial lighting. The new union depot at Stillwater is lighted throughout with the system, and the lights are also carried out in the sheds and platforms around the building. This new union depot building is an architectural gem, being one of the handsomest railway station structures to be found in the west. It is finished in hard wood, is beautifully frescoed, and fitted throughout with beautiful combination gas and electric light fixtures. To the judgment and good taste of J. C. O'Gorman, receiver of the Stillwater Transfer company, by whom the depot was built, is largely due the credit of Stillwater possessing a building so handsome, and so perfectly adapted to the purpose for which it was designed. The incandescent wiring of the building was done by the United States Electric Lighting company, and the fixtures were also furnished by the same company.

The Minnesota state prison, located at Stillwater, has for some time past been operating a 300 incandescent light plant for the illumination of the offices, dining room and reception rooms, and kitchens of the prison, and the warden's and deputy warden's residences adjoining the prison. The lights have proven so satisfactory that the prison officials decided to extend the system and light the cells by means of 10 candle power lamps, one of which is to be placed in each cell. They consequently closed contract with J. H. Woolsey, of the United States Electric Lighting company, for a 600 light increase of the present plant. This will make the Minnesota state prison undoubtedly the best lighted prison in the country. B.

Notes From Kansas Towns.

ELLSWORTH, May 15:—At a mass meeting held at the opera house a short time ago to discuss the feasibility of putting in a $12,000 electric light plant, strong sentiment in favor of purchasing a plant was manifested.

The paid up capital stock of the Stockton Electric Light company is $7,500. The officers are C. C. Woods, president; D. E. Miller, vice president; H. C. Reins, treasurer. Stockholders, C. C. Woods, D. E. Miller, H. C. Reins, J. M. Wells, O. A. Higgins. The company has now in use 15 arc and 175 incandescent lights.

Peter Bauer, who for many years has been superintendent of the Wichita Gas & Electric Light & Power company has resigned his position, and will accept a position with another company now forming in the same city.

The Kansas City Electrical company has been formed with a capital stock of $10,000.

At Chetopah, Kan., E. Ruebel, superintendent and electrician of the Western Engineering and Electrical company, had the misfortune to break his arm while coming from Winfield, Kas., on the D., M. & A. R.R.

A company is being formed in Wichita for the purpose of serving the city with incandescent lights. It is proposed to buy the franchise of the Archer company and commence work at an early date in putting in lights. By this system each building is supplied with the battery. Whole blocks are lighted from one battery located in some closet or out of the way nook in the block. Some of the leading business men are figuring on the matter, and it is thought the company will be formed and thoroughly organized in a few days. McD.

From the Pacific Slope.

SAN FRANCISCO, May 7.—The dynamos of the steamer Queen of the Pacific, which was sunk in Port Harford harbor will be taken out and will be replaced by others of improved type.

The San Barnadino Electric Light and Power company will enlarge its plant by putting in two new turbines and two dynamos.

Napa has the only incandescent central station plant in California. The Heisler system is employed. The Napa Electric Light company has a contract for lighting the city for 18 months by 800 candle power lamps

The Southern California Motor company is securing right of way for a line from Colton to Riverside. S.

THE ELECTRIC LIGHT.

An electric light plant will be installed at Superior, Neb, in the fall.

Electric lights will be installed at the Fairmount, W. Va., mines of the Montana Coal and Coke company.

The Conneaut Electric Lighting company has been organized at Columbus with a capital of $10,000.

A 250-light incandescent plant will be installed at Belding, Mich., by the Thomson-Houston company of Chicago.

The plant of the Thomson-Houston Electric Light company at Allegheny City, Pa., was put in operation May 5th.

Carroll, Ia., will be lighted by the electric light. The private enterprise of a citizen will accomplish this desirable result.

The Edison Electric Light, Motor and Power company, of Pontiac, Mich., has formed with a capital stock of $12,000.

Frederick, Md., has decided to purchase the Thomson-Houston electric light plant located there at a cost of $14,500.

An isolated incandescent plant has been purchased by Zeese & Co., of Chicago, of the Thomson-Houston company, Chicago.

The Minnesota Brush Electric Light company will increase its capital to $60,000. The limit of its indebtedness is raised to $100,000.

The Swedish government has ordered the teachers at the military school at Karlskrona to instruct the pupils in the management of arc and incandescent lamps.

The Excelsior Springs Electric Light company of Excelsior Springs, Mo., has purchased a 50 arc light plant of the Thomson-Houston company of Chicago.

The Edgewater Electric Light company of Chicago, has been incorporated with a capital stock of $100,000. The incorporators are John Lewis Cochran, S. Wilner Connel and John C. Scovel.

The New York aldermen have passed an ordinance requiring all linemen and lampmen of the electric light companies to wear badges bearing a distinguishing number and the name of their company, under a penalty of $25.

The electric lights on the Brooklyn bridge are so dazzling that pilots approaching the structure have had difficulty in seeing the lights of vessels and in judging their distance. Reflectors will probably be employed to confine the lights as nearly as possible to the bridge.

The illumination of the Brussels Exhibition is divided into three sections, viz., the lighting of the buildings by electricity, the lighting of the fountains by the same means, and the lighting of the gardens by gas. For the last named purpose 20,000 gas jets will be employed.

A local company styled the Waterhouse Electric Light company, of Baltimore, lately formed, are operating 500 full arc lamps and 700 incandescents. They light a neighboring theater and the stage is arranged with incandescent lamps operated by rheostats so that the same stage effects are secured as by the use of gas, in the degree of light required, and by colored globes, the color effects necessary, with less danger from fire among the flies and wings of the stage.

A dispatch from Utica dated May 11th, says: In Steuben Park, this city, to-night, a broken wire from some cause hung from an electric light pole and extended nearly to the ground, terminating in a crook. Several young men standing around dared each other to touch it. Finally Thomas Murphy, aged 18, a tinsmith's apprentice, reached for the wire with a short stick. Immediately, so his companions say, he seemed to be drawn toward the suspended wire, and then he fell, dying in a few minutes.

A French inventor has applied a minature electric incandescent lamp to watch dials, the current being supplied by a small pocket battery. The dial is of ground glass, and the lamp behind it lights it up, the effect being enhanced by a flat reflector. A key is included in the circuit to close the current when the light is required. It is obvious that there are circumstnces in which such a device will be useful, and where it is inexpedient to strike a light to see the time—such places as mines or in military operations. The apparatus is equally applicable to clocks.

The great hall in the St. Louis exposition building, which is being fitted up for the reception of 12,000 persons during the coming festival of the American sængerbund, will be illuminated by the Heisler system. The managers of the exposition have decided not to employ any arc light. The isolated plant which is located in the building not being sufficiently large for this purpose, the Heisler system was called upon to furnish about 600 lights of 30 candle power for the illumination of the main parts of the hall and it is expected that the effect will be suitable for the occasion.

According to the New York *Sun* 87 fires have been caused in the metropolis by electric light wires since 1880. In commenting on the condition of the circuits the same journal says: "The suspended wires have become so numerous that they jostle each other, and every moment when a wind is blowing there is peril of the diversion of the high current of an arc light circuit to some telephone, telegraph, fire department, or police wire, carrying disaster to unexpected quarters. The deterioration wrought by time and the elements in the insulating material covering those arc light wires infinitely increases the danger, for wherever there is a bare spot of wire the current is ready to leap forth for silent, instantaneous murder, or the starting of a conflagation. The fraying of the insulation covering by wires rubbing against each other, by their touching spikes and posts and signs, by the formation of ice upon them, and the action of the wind in blizzard weather, and through many other causes, has produced the rag and tatter so conspicuous on the wires all over the city."

At the general meeting of the Royal Mail Steam Packet company, Eden Colville president of the corporation said: "We have put the electric light into twelve of our ships, and from the experience we have had, from what we hear from the passengers generally, we think that it is an exceedingly judicious expenditure. It is a favorite light among the passengers. It is a much safer light, I think, as against fire than burning oil lamps or candles. I cannot say it is a saving in expenditure actually, but we feel the effect in the increased number of passengers we carry, to whom it gives great satisfaction."

Fayetteville, Ark., was illuminated by the Heisler system of electric lighting for the first time May 4th and the occasion was seized for a general celebration in the way of a ball and supper. Fayetteville Electric Light & Power company was organized January 31, 1888, and is composed of local capitalists. The board of directors is as follows: J. L. Duke, L. Baum, H. F. McDanield, Albert Byrnes, E. B. Harrison, J. L. Cravens and Geo. T. Lake. The officers of the company are: President, E. B. Harrison; Treasurer, W. R. McIlroy; Secretary and General Manager, W. E. Anderson. It is the purpose of the company to furnish light and power to factories and also to heat buildings and residences. The night of inauguration of the system 150 lights were burning.

THE ELECTRIC MOTOR.

The Hudson, N. Y., Electric Railway company has been organized with $50,000 capital stock.

The directors of the electric railroad at Rochester, N.Y., report that they are ready to build but they have as yet been unable to secure the right of way for their road.

The stockholders of the New York Electric Railway company have elected these trustees: F. F. Thompson, Cyrus W. Field, R. E. Deyo, Stephen D. Field, Charles Dimon, Edward Johnson, Charles H. Coster, Spencer Trask, and F. S. Hasting.

"We have an electric street railway in operation out in Wichita," said a Kansas man. "It doesn't haul many passengers, yet it is a paying institution. Two hundred and fifty citizens have agreed to pay five cents apiece each day to keep the road running, whether they ride or not. So the cars go spinning up and down the streets, giving a stranger the impression that business is everlastingly booming. Just about half the time the cars are empty, but the company loses no money, for the voluntary public contribution of $875 a week is a good guaranty."

A dispatch from New York says: An examination of electrical railroad statistics shows that there are already 130 miles of road in operation on this continent. Of this number 21 miles are in operation in Pennsylvania, 16 miles in New York, 10 in Ohio, and 83 miles in New Jersey, Maryland, Colorado, Michigan, Missouri, California, Alabama, Virginia, Kansas, Delaware, Rhode Island, and Ontario combined. Almost all of this building has been done in the past year. There are in course of construction, or contracted for, 150 additional miles in New York, Massachusetts, Connecticut, Tennessee, Ohio, California, Pennsylvania, Nebraska, Kentucky and Minnesota. Of these various roads constructed and constructing, in sixty-two different towns and cities, the Van Depoele system is used, or to be used, in seventeen cases, the Daft system in fifteen cases, the Sprague system in seven cases, and the Bentley-Knight, the Heart, the Henry, the Julien, and other systems in the remaining cases. The last named system is to be used on the projected New York and Harlem Fourth Avenue Electrical road, while the Daft system is in use at Los Angeles, where the first electrical railroad was opened for business in the winter of 1886 7.

THE TELEGRAPH.

Heavy winds did considerable damage to telegraph lines in Indiana and Illinois the latter part of last week.

Uncle Rastus (in telegraph office) — Has yo' got a envelope, sah? Operator — What do you want of an envelope, Uncle Rastus? Uncle Rastus — Dis expatch, sah, am ob a wery private nature, an' I wants it sent sealed.— New York *Sun*.

The Chicago *Times* quotes a republican United States senator as saying that not a half dozen senators would vote for the government purchase or construction of a telegraph line and adds: "This statement is as gratifying as it is surprising. The country has been led to believe that a very large proportion of the senators, if not a majority, were inclined to establish a postal telegraph system similar to that of Great Britain. The fact that Senator Cullom, Senator Edmunds, and others have introduced bills for the establishment of such a system, or favored it in their public utterances, has been calculated to induce that belief, and that either the purchase or construction of lines by the government would command strong support. At times the adoption of one or the other of these propositions has seemed probable."

THE TELEPHONE.

During a thunder storm in Chicago last week the lightning played about the switch-board of the telephone company in a way decidedly uncomfortable to the nerves of the operators, but little damage was done.

An apparatus for examining rocks, to determine whether they contain metallic ores, has been patented by John R. Williamson, of Seattle, Washington Territory, and William W. Hickies, of Oakland, Cal., says the *Scientific American*. One pole of a battery is connected with one terminal of a telephone receiver by means of a wire in the usual way, the remaining pole of the battery being connected by a conductor with a brush provided with a suitable handle, while the remaining terminal of the telephone receiver is connected by a conductor with a similar brush having a like handle. In examining rocks in place, the two brushes forming the terminals of the conductors connected with the telephone and battery are drawn along the face of the rock, while the telephone is held to the ear of the operator. If the rocks contain metals they conduct the current, and the movement of the brushes along the rough face of the rock causes variations therein, which are audible through the telephone, there being no sounds produced when the rock contains no minerals. In examining detached portions of rock, the the latter are placed upon a conducting plate connected with the telephone through the battery, and the brush at the other terminal is touched to the rock, which, if it contains metal or metallic ores, will cause sounds to be heard in the telephone. Instead of using the conducting plate, the fragments of rock may be examined by being placed upon insulating material, and bringing both brushes in contact with each specimen. Other means of indicating the passage of the current may be employed instead of the telephone receiver, as the operator may place the conductors on his tongue and note the sensation due to the completion of the circuit, or a galvanometer may be employed, or a paper saturated with salt, which will be decomposed by the current, making marks on the paper, although the telephone receiver is preferable from its portability and effectiveness and the ease with which it is managed.

Personal Paragraphs.

Henry B. Slater, of Detroit, Mich., was a guest at the Chicago Electric Club last week.

Dr. F. A. Freeman, a patent expert of Washington, D. C., was in Chicago a few days ago.

Among the list of persons promoted in office and rank in Germany appears the name of Prof. Siemens, upon whom the grade of noble is conferred.

T. J. Ryan is south in the interest of the Silvey Electric company of Lima, O. He reports business very good in the section comprising Tennessee and Alabama.

D. R. Russell, vice-president of the Parker-Russell Mining and Manufacturing Co., of St. Louis, Mo., was in the city for several days last week and the first part of this week.

Jarvis B. Edson, mechanical expert, has left the quarters he occupied for fourteen years at 91 Liberty street, New York, and has removed to larger and more commodious offices at 145 Broadway and 86 Liberty street, nearly opposite.

We regret to have to record the death of T. R. Crampton, M.Inst C.E., which occurred at his residence in Ashley place, Westminster, on the 19th inst. Mr. Crampton will be remembered as having successfully laid one of the first cables which connected England with France in the year 1851, a task the whole engineering responsibility of which devolved upon him. Mr. Crampton's other achievements were chiefly in the field of railway extension; but he continued to take interest in telegraphic engineering, and was at one time a member of the Council of the Society of Telegraph Engineers and Electricians. Mr. Crampton was seventy-one years of age, having been born in 1816 at Broadstairs, Kent.—*London Electrician*.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	400
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	26	27
Missouri and Kansas	70	72

Miscellaneous Notes.

Electricity is incomparable for illuminating purposes, but for the purpose of killing criminals it will never supersede the coal-oil can.—*Lincoln Journal*.

The announcement is made that a musical instrument which can be played only by electricity, and which produces "music unique in sweetness," has been invented by an Italian.

A gentleman who is interested in the copper syndicate in Paris has recently been interviewed. He predicts a collapse of the market, but does not think that the fall will be as marked as in the case of tin.

A dishonest workman who was employed in putting in a burglar alarm in Brooklyn last week decided to plunder the house before the apparatus could expose marauders. He decamped with $200 worth of silverware, and was subsequently arrested.

English journals report that there is a probability that the new Metropolitan theaters bill will contain a clause making electric lighting compulsory on the part of proprietors and lessees. "This, if true, is indeed good news," says the London *Electrical Review*.

A lady in LaGrange wrote Thomas A. Edison, says the Atlanta *Constitution*, requesting him to invent a trumpet that would enable her husband to hear. The wizard immediately sat down and wrote the lady to wait just a few months and that husband of hers would think he heard the stars falling.

The acid or saline electrolyte in voltaic batteries has, for certain purposes, been solidified by the use of various gelatinizing substances of vegetable or animal origin; M. Messerole obtains a similar result in the case of an alkaline electrolyte by the use of a solution of soap in caustic potash or soda, of such strength as to gelatinize when the hot solution is allowed to cool. The spilling of the fluid is thus obviated, and its evaporation retarded to a great extent. No information is afforded, however, as to the resistance offered by the solidified electrolyte to the passage of the current.

M. Bouty has shown that the addition to fuming nitric acid of very minute proportions of an alkaline nitrate has the effect of considerably augmenting the electrical conductivity of the liquid, says the London *Electrical Engineer*. He also points out that, up to a certain point, the addition of water to the concentrated acid increases its conductivity almost in the proportion of the quantity of water added. The addition of small proportions of dehydrating substances, such as concentrated sulphuric acid or anhydrous sulphurous acid, has the same effect, apparently by reason of the production of electrolytic compounds of sulphuric or phosphoric and nitric acids. Lastly, M. Bouty has demonstrated that nitric acid in different stages of dilution does not contain the same electrotype.

A press despatch from Lancaster, Pa., of recent date reads: "While the family of George Heffner, at Eagle Point, on South mountain, near Womelsdorf, this state, was eating supper, lightning struck the house. Two distinct reports were heard, a stroke going down each of the chimneys. Mary the oldest daughter of the family, was waiting on the table at the time. The lightning tore up things in the pantry, and coming out struck into the shoes the girl had on her feet. The uppers and soles of the shoes were torn into threads, and her feet are blue and the skin is torn off. When the girl was stricken she had her hand on the door knob and in the other hand she held a tumbler of water. Both hands are very weak and she is unable to walk. The carpet and oil cloth, except where Mary stood, were torn into pieces."

A. H. Botsford says in the *Globe Democrat*: "I read in a paper a short time ago an account of a magnetic well, which the writer evidently thought was something wonderful. In reality it is a very common occurrence to find magnetism in drilling deep wells. I have been engaged in the business in this city for eight years, and it is seldom that I penetrate the earth to any great depth without coming in contact with magnetic influences. On withdrawing the auger when it is highly magnetized spikes of other iron substances adhere to it with great tenacity. These veins or streaks of magnetism occur at various depths, and sometimes but a few feet of the stratum is impregnated with it, and on going below its influence is not noticed on the auger. We sometimes encounter magnetism two or three times in the same well."

The bureau of statistics, in Berlin, has recently issued some curious information with regard to the number of steam engines in use in the chief countries of the world and the amount of motive force which they represent. The United States stands first, with a total horse power of 7,500,000; next comes Great Britain with 500,000 less; Germany has 4,500,000; France, 3,000,000, and Austria, 1,500,000. In these figures the motive power of the locomotive, which number 105,000 throughout the world, is not included. They represent, collectively, a total of 30,000,000 horsepower. Summarizing these figures, and remembering that a steam horse power is equal to the power of three actual horses, and that the strength of a living horse is equal to that of seven men, we arrive at the following result: The steam engines of the world do the work of double its working population.

Business Mention.

The Chicago Rawhide Manufacturing company of 75 and 77 East Ohio street, Chicago, are making a rawhide belt for dynamos which is highly spoken of by users.

The Partz Electric Battery company, of 1723 Chestnut street, Philadelphia, Pa., are out with a new catalogue which contains specific and exhaustive information regarding primary batteries of their make. The catalogue is well illustrated.

The United States Electric Fire Alarm company of Evart, Mich., have recently wired and placed in position a large annunciator and call bell system of their manufacture in the new hotel at Mt. Clemens, Mich., erected by William E. Hall of that place.

The Waterhouse company, of Hartford, Conn., have issued a neat catalogue of their apparatus, and we note great progress in the work done during the year. Such a demand has suddenly come up for their system that the capacity for turning out work has been recently doubled.

The Leavenworth Coal Co, Leavenworth, Kan., has now placed in its electric light station the third Heisler dynamo, of a capacity of 1,000 16 candle power lamps. Mr. Walker, superintendent of the plant reports on the 29th of April, "The machine is up and running. We like it very much. The regulator works like a charm." This company was one of the first to introduce the Heisler system for central station business and has on various occasions expressed its great satisfaction with it. This new increase of the plant, largely for residence lights, can be taken as a proof that the company finds the electric light business profitable and that the Heisler guaranties, in regard to the economical running of the plant have been fully sustained.

The Central Electric company are settled in their new building at 42 La Salle street, Chicago. The first floor is handsomely furnished for exhibiting their many electrical specialties and taking care of their large and increasing counter trade. The basement is overflowing with okonite, underwriters, Candee weatherproof and other wires. On the third and fourth floors are carried insulators, cross-arms, pins and brackets, shovels, bars, line wire, reels and tools of all kinds, their stock being very comprehensive. The shipping facilities of this wide awake company are most complete. Electrical people sending their orders to the Central Electric company will have them filled intelligently and be assured of prompt and courteous treatment.

Leonard & Leard, general agents for the Edison United Mfg. company in Illinois, Wisconsin and Iowa, have issued a neat catalogue, giving a list of Edison plants in those states with testimonials from users. As might be inferred the list is a large one, and shows 91,690 lights installed up to April 1st, 1888. The showing for the first quarter of 1888 is particularly noticeable. The lights installed each year since 1882 follow: 1882, 3,648; 1883, 4,337; 1884, 7,047; 1885, 15,819; 1886, 16,189; 1887, 27,066; the first quarter of 1888, 10,681. Inasmuch as the number of lights installed the first quarter of the current year exceeds the number installed during the entire year 1886, and is equivalent to about 61 per cent. of the entire business for 1887, the prospects for a phenomenal business this year are very flattering. The catalogue is handsome typographically and contains much that is interetsing to users of incandescent lights of this system.

The *Scientific American*, of April 28th, publishes a full page illustration, in addition to several other engravings, showing various departments in the establishment of James W. Queen & Co., of Philadelphia, manufacturers of scientific apparatus of which no small part is in the electrical line: "There are at present six departments, arranged under the following heads: Physical and chemical, engineering, ophthalmic, microscopical, the magic lantern department, and the photographic department. The headquarters of these departments are at 924 Chestnut street, at the site occupied originally by Mr. Queen; but the business having enormously outgrown the building, some of the departments were obliged to seek quarters for apparatus in other buildings in the vicinity of the main offices of the establishment. The factory, in which are made a large proportion of the instruments and apparatus sold by Queen & Co. was long ago removed to more commodious quarters, now occupying a floor extending through a city block and fifty five feet in width. * * * While all the apparatus might come under the general heads of physics and chemistry, there is a special department, (number 4) devoted to these sciences with their various branches, as exemplified in apparatus for research and for practical use. Under this head comes the department for electrical instruments, galvanometers, bridges, resistance coils, reading telescopes, ammeters, voltmeters, and similar instruments, which include those for the most careful research, as well as for the use of the practical electrician in the dynamo room. This particular branch of business has grown to very large proportions within the last few years, and is now very complete. The sale of ammeters and voltmeters, both for scientific measurements and for practical work, is one of the specialties which has assumed large proportions, and they sell to universities, electric lighting companies, users of batteries, dynamo machines, in short to all of those industries where the ammeter and voltmeter have become as necessary as the steam gauge. It is perhaps well to mention that Queen & Co. are sole agents for the popular and well known Ayrton & Perry instruments for electrical measurements."

The Waterhouse Electric and Manfg. Co., of Hartford, Conn., began delivering apparatus in November, 1886, and since have taken orders for and installed the following plants—an excellent showing for such a short time, and a proof of the favor which it is receiving: Gray Harbor, W. T., 10 arc lights, Washington Lumber Mill; North Fork, Cal., 10 arc lights, Humboldt Lumber Mill Co.; Cincinnati, O., 180 arc lights, Centennial Exposition of the Ohio Valley; Chicago, Ill, 20 arc lights, E. Hart, American Tailors; New York City, 35 arc lights, Church & Co., 129 Pearl St.; Sacramento, Cal., 20 arc lights, Southern Pacific R.R. Co. shops; Fort Bragg Cal., 10 arc lights, Ft. Bragg Electric Light Co.; Livermore, Cal., 10 arc lights, city of Livermore; Willimantic, Conn., 100 arc lights, Willimantic Electric Light Co.; Newark, N. J., 300 arc lights, Schuyler Electric Light Co.; Fresno, Cal., 100 arc lights, Fresno Gas Co.; Wellsville, Ohio, 70 arc lights, Citizens' Electric Light and Power Co.; Nevada City, Cal., 70 arc light, Nevada Electric Light Co.; Grass Valley, Cal., 70 arc lights, Grass Valley Electric Light Co.; Cadillac, Mich., 70 arc lights, Central Station; Washington, Ind., 35 arc lights, Washington Gas Co.; Ashland, Ky., 60 arc lights, Ashland Electric Light and Power Co.; Baltimore, Md., 500 arc lights, Waterhouse Electric Co.; Joliet, Ill., 105 arc lights, Joliet Electric Light Co.; Willimantic, Ct., 70 arc lights, Williamantic Electric Light Co.; Wien, Austria, 35 arc lights, Bruckner, Ross & Consorten; Hartford Ct., 35 arc lights Hartford Light & Power Co.; Athol, Mass, 25 arc lights, Miller's River Gas Co.; Orange, Mass., 75 arc lights, New Home Sewing Machine Co.; Springfield, Ohio, 25 arc lights, Warder, Bushnell & Glessner; Erie, Pa., 30 arc lights, Jerecki Mf'g Co.; Chebanse, Ill., 20 arc lights, Leroy Payne's Horses' Home; Providence, R. I., 35 arc lights, Taft, Weeden & Co., Weybosset Mills; Union Hill, N. J., 70 arc lights, R. & H. Simon, silk mill; New York City, 42 arc lights, James A. Hearn & Son; Whitinsville, Mass., 35 arc lights, Whitin Machine Co.; Blackstone, Mass., 35 arc lights, Evans, Seagraves & Co.; Pawtucket, R. I. 35 arc lights, Slater Cotton Co.; Pawtucket, R. I., 83 arc lights, E. Jenckes Mfg. Co.; Lawrence Mass., 45 arc lights, Atlantic Cotton Mills; San Francisco Cal., 180 arc lights, W. C. Clark; Berlin Falls, N. H., 35 arc lights, Forest Fibre Co.; Brooklyn, N. Y., 35 arc lights, Church & Co.; Newark, N. J., 10 arc lights, E. R. Carhuff; Matamoras, Tex., 52 arc lights, Francisco Armendaiz; Philadelphia, Pa., 8 arc lights. Chas. E. Shedaker; Cadillac, Mich., 6 arc lights, Cobb, Mitchell & Co.; WilkesBarre. Pa., 35 arc lights, WilkesBarre Lace Mfg. Co.; Chicago, Ill., 20 arc lights, E. Hart, American Clothiers; Philadelphia, Pa., 15 arc lights, Ab. Kirschbaum & Co.; Baltimore, Md., 700 incandescent, Waterhouse Electric Co.; San Francisco, Cal., 140 incandescent, Ferry boat Piedmont; Osakis, Minn., 100 incandescent, Osakis Roller Mills; Hartford, Conn., 150 incandescent, Conn. Mutual Life Insurance Co.; Providence, R. I., 100 incandescent, Hopkins, Pomeroy & Co.; Providence, R. I., 100 incandescent, Taft, Weeden & Co.

Electrical Patents.

Issued May 8, 1888.

382,209. Electric Railway Signal. Burton H. Gedge, Covington, Ky.

382,332. Switch for Electric Circuits. Clarence C. Stirling, Hartford, Conn.

382,333. Switch for Electric Circuits. Clarence C. Stirling, Hartford, Conn.

382,335. Alternating Current Dynamo Electric Machine. Elihu Thomson, Lynn, Mass.

We give the following claims:

"1. In a self-exciting alternating current generator, a commutator for rectifying the current taken from the machine to the exciting coil or circuit, in combination with a reactive coil in the connection to the commutator.

"4. The combination, with the branch supplied with current from a main carrying alternating currents or their equivalent, as described, of a commutator in the branch, and a reactive coil provided with means for adjusting its self-induction or reaction.

"8. The combination, with an alternating current dynamo having a field coil in a branch or derived circuit, of a self-inductive coil in said branch, whereby a field coil of comparatively low resistance may be employed."

382,336. Alternating Current Regulator. Elihu Thomson, Lynn, Mass.

Claims 1 and 6 are: The combination, with a reactive coil having means whereby the closure of its magnetic circuit may be varied, of a controlling mechanism responsive to variations in the strength of an alternating current.

"6. The combination, with an alternating current dynamo, of a field coil connected to the armature of said dynamo, a reactive coil in the connection to the field coil having means whereby its counter electromotive force may be governed, a motor mechanism for operating the adjusting device, and a controller electromagnet, connected to the alternating current circuit of the dynamo."

382,358. Plate for Storage Batteries. Charles D. P. Gibson, New York, N. Y.

382,415. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J.

We give the first and last claims:

"1. The combination of a source of current of high tension, a circuit extending therefrom, two or more tension reducing converters having their primary circuits connected with said high-tension circuit, a translation circuit supplying a variable number of translating devices, to which the secondary circuits of all said converters are connected, and switches for making and breaking the primary and secondary connections of individual converters."

"4. The combination of a source of current of high tension, a circuit extending therefrom, two or more tension reducing converters having their primary circuits connected with said high tension circuit, a translation circuit supplying a variable number of translating devices, to which the secondary circuits of all said converters are connected, one or more separate circuits extending from the central station, electro-magnets energized thereby, and switches controlled by said electro-magnets for making and breaking the primary and secondary circuits of individual converters."

382,420. Secondary Battery. Ludwig Epstein, Martinikenfelde, near Berlin, Germany.

382,421. Electric Arc Lamp. Richard E. Fenner, Chicago, Ill.

382,439. Electric Burglar Alarm. Henry C. Roome, Jersey City, N. J. Filed Sept. 15, 1884. Serial No. 143,063.

The first claim is as follows: "In an electric burglar alarm comprising an internal circuit and an external circuit, the combination of a set of variable resistances in connection with the internal circuit, a set of variable resistances in connection with the external circuit, mechanism for varying the resistance in the internal and external circuits at predetermined intervals, a supplemental source of electric energy, and mechanism for throwing the supplemental energy into connection with the variable resistances at pleasure."

382,444. Electric Burglar Alarm. George F. Taft, Boston, Mass.

382,461. Telephone System. Richard N. Dyer, New York, N. Y.

Claims 1 and 12 are given: "1. The combination, with two or more telephone transmitters and induction coils through which the transmitters are connected with the telephone lines, of a current supplying circuit extending to said two or more telephone transmitters and independent multiple arc connection between such transmitters and said current supplying circuit.

"12. In a telephone system, the combination, with a telephone line, a telephone transmitter, a telephone receiver, an induction coil, and a signaling bell, of a current supplying circuit, a connection from such supply circuit to the telephone transmitter and induction primary, another connection from the supply circuit through the bell, a circuit controller in the latter connection for producing signal impulses, and a switch alternately shifting the line connection from the telephone receiver to the bell and opening and closing the connection from the supply circuit to the telephone transmitter."

382,474. Multiple Switch-Board. Milo G. Kellogg, Hyde Park, Ill.

The invention relates to a telephone exchange system in which the subscribers' lines are metallic circuits.

It consists, first, of a multiple switch-board system of operating an exchange and testing at any board to determine whether any given line is in use; secondly, of a certain construction of spring-jack switches and test bolts, applicable to multiple switch-board systems.

382,475. Multiple Switch-Board. Milo G. Kellogg, Hyde Park, Ill.

The 10th claim is given: "10. In a telephone exchange system, two subscribers' lines temporarily connected together for conversation, in combination with a calling generator or battery, a clearing out annunciator, a calling key and a switching device, said key and said generator being in a wire or circuit grounded on one side and connected to the circuit of said lines on the other side, said clearing out annunciator being in a loop, the two ends of which are connected to two contact bolts of said switching device, said switching device having two contact pieces, each connected to its side of the circuit of said lines, and said contact pieces being adapted to be brought into connection with said bolts, whereby at the will of the operator he may loop the clearing out annunciator in and out of the circuit of the lines so connected together, and may ground said circuit through the calling generator."

382,476. Multiple Switch Board. Milo G. Kellogg, Hyde Park, Ill.

The invention relates especially to a telephone exchange system in which the subscribers' lines are normally grounded at the central office and consists in testing apparatus and means for temporarily disconnecting any line from ground when it is switched for conversation.

Claim 1 read as follows: "1. In a telephone exchange system, the combination of a telephone line entering the central office and separated into two branches, with a line switch containing two normally insulated metal parts, said parts being adapted to be brought temporarily into contact when said line is switched for conversation, and one of said parts being connected to one of said branches and the other of said parts being connected to the other of said branches, a back contact relay and a battery, both in the circuit of said branches, as described, and a ground wire, said line being connected to one of the contact points of said relay, and said ground wire being connected to the other contact point of said relay."

382,477. Multiple Switch-Board. Milo G. Kellogg, Hyde Park, Ill.

We give the 3rd and 5th claims: "3 In a telephone exchange system, the combination of two metallic circuit lines temporarily connected together for conversation, a test circuit containing a test receiving instrument and a test battery, said test circuit being electrically connected on one side of said instrument and battery with said lines when they are thus connected for conversation, and then only, a test bolt connected to said metallic circuit, and a switching device connected to said test circuit on the other side of said instrument and battery, adapted at the will of the operator to be brought into electrical connection with said test bolt.

"5. In a telephone exchange system, the combination of metallic circuit lines, two or more switch-boards for said lines, test circuits, one at each board, each test circuit containing a test receiving instrument and a test battery, said test circuits being electrically connected on one side to their test-receiving instruments and test-batteries, and normally disconnected from said lines, switching devices at each board adapted to connect any two of said lines together for conversation and to connect them temporarily or when thus connected electrically with said test-circuits on said side of their test-receiving instruments and batteries, test bolts, one for each line on each board, each test-bolt being connected to its line when it is switched for conversation and switch-testing devices at each board, each connected to the test-circuit at its board on the other side of the test-receiving instrument and battery, and adapted at the will of the operator to be brought into electrical connection with any of the test-bolts at her board."

382,483. Electric Motor for Railway Cars. William M. McDougall, East Orange, N. J.

382,515. Electric Railway Signal. Constant F. de Redon, New York, N. Y.

382,518. Telephone Exchange. Horace H. Eldred, Boston, Mass.

We give the claim: "The combination, substantially as hereinbefore set forth, of a series of subscribers' lines converging to a common switch board, switch apparatus adapted for temporarily connecting any two of said lines, switching and calling mechanism mounted on an operator's table and in a loop connected with said switching mechanism, and indicators to notify the table-operator of connections made on the switch-board with the loop-lines on the table."

382,560. Electric Lamp Filament. Carl Seel, Berlin, Germany.

382,589. Electric Motor. George F. Card, Covington, Ky.

382,593. Electric Stop Motion for Knitting Machines, Charles Draper, Springfield, Mass.

382,599. Automatic Switch for Secondary Batteries. Camil'e A. Faure, New York, N. Y.

382,625. Automatic Electrical Switch. Frederick Stitzel, Louisville, Ky.

We give the 6th claim: "In an electrical switch, the combination with two electro-magnets, of a pivoted level above said magnets and carrying weights on opposite sides of its fulcrum, a series of contact blocks with which an arm of the lever is adapted to make contact, and two batteries electrically connected with the contact blocks and coils of the magnets, whereby when one battery becomes weak it will be cut out and the other battery switched into circuit automatically when the arm of the lever moves over the contact blocks."

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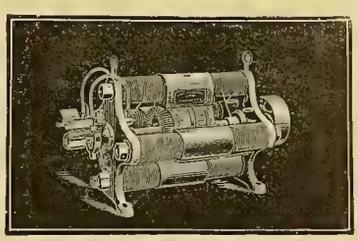

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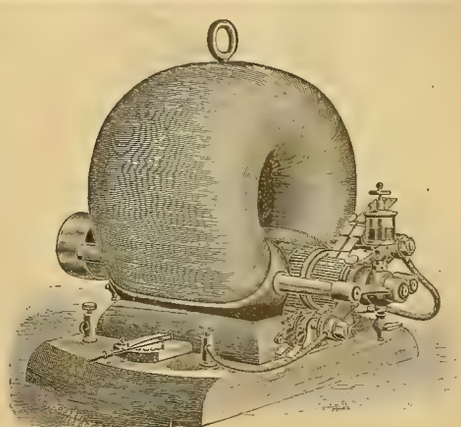

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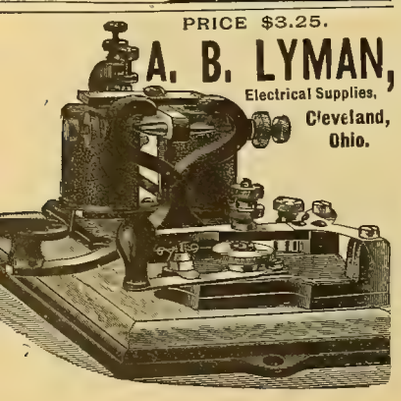

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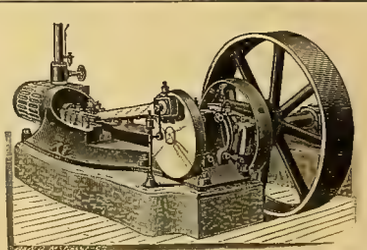

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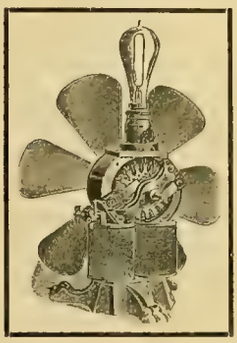

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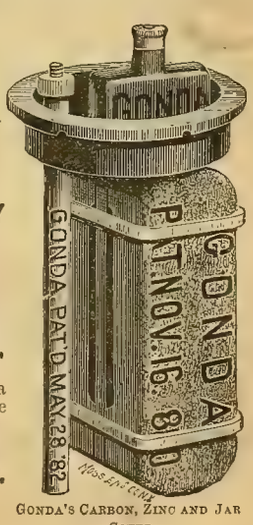

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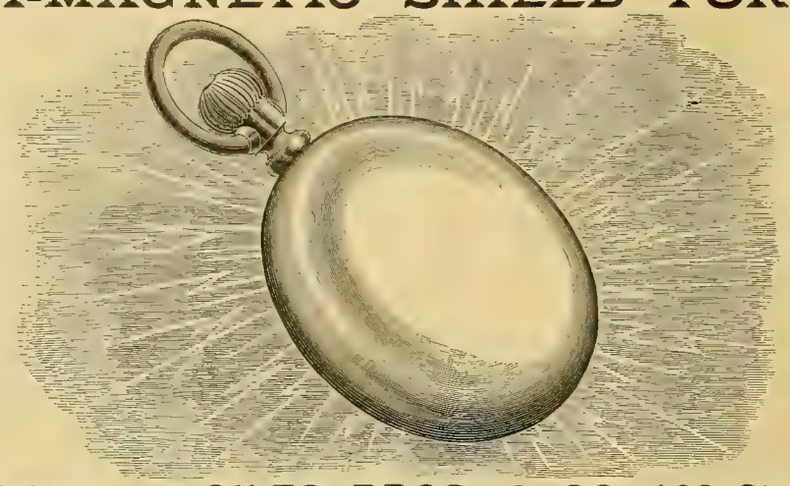

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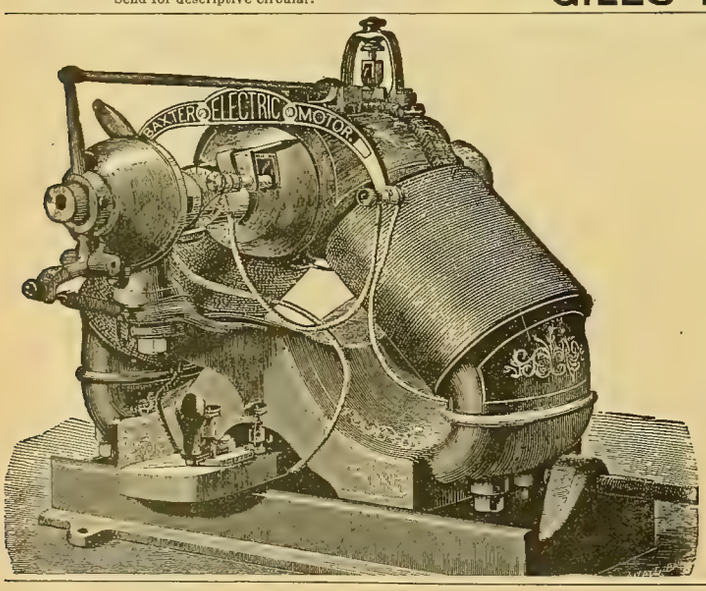

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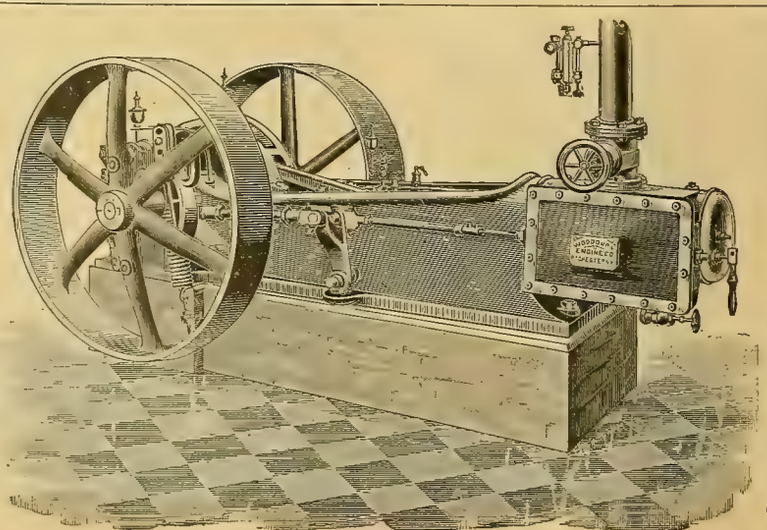

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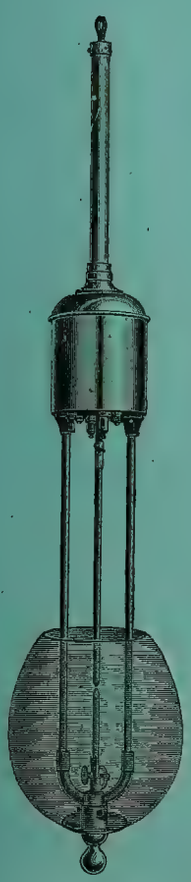

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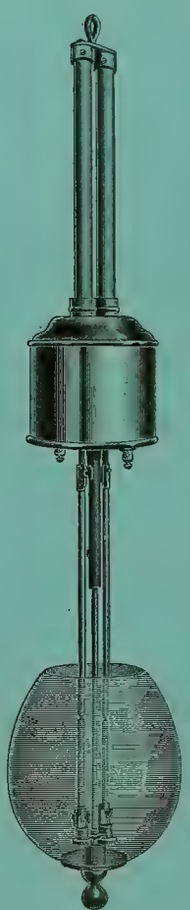

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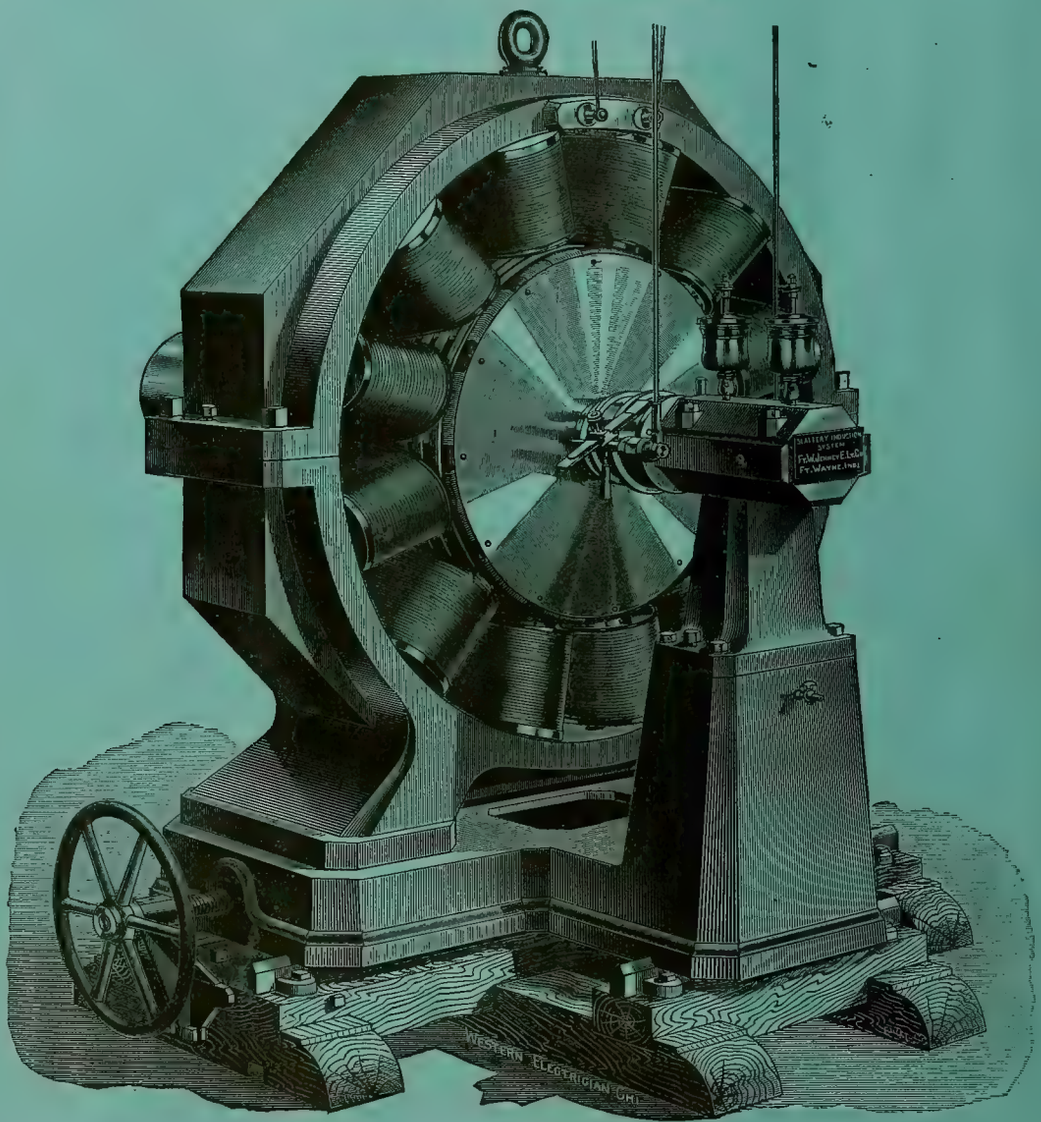

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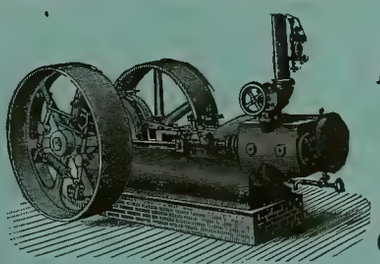

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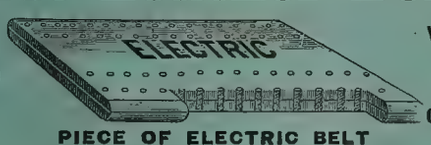

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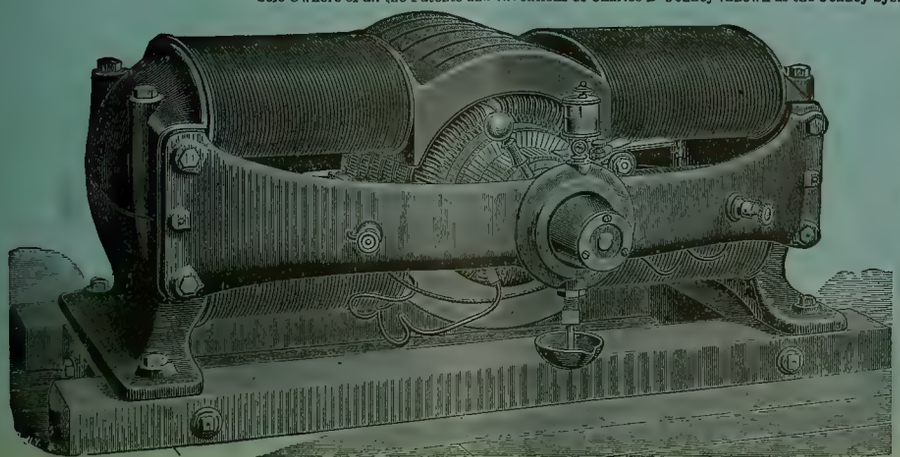

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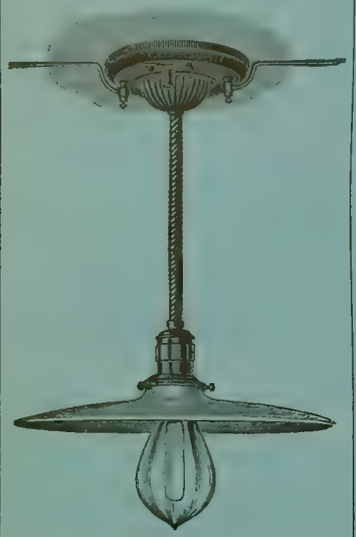

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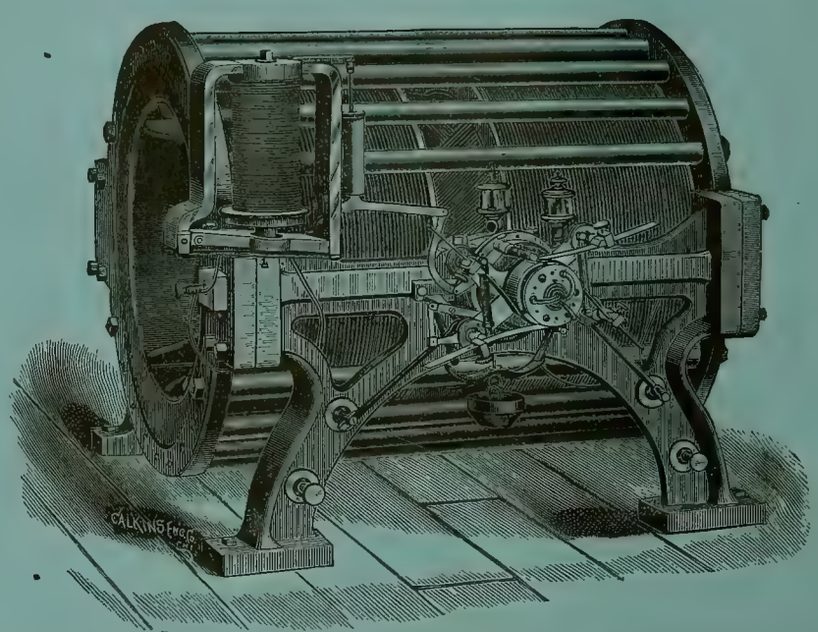

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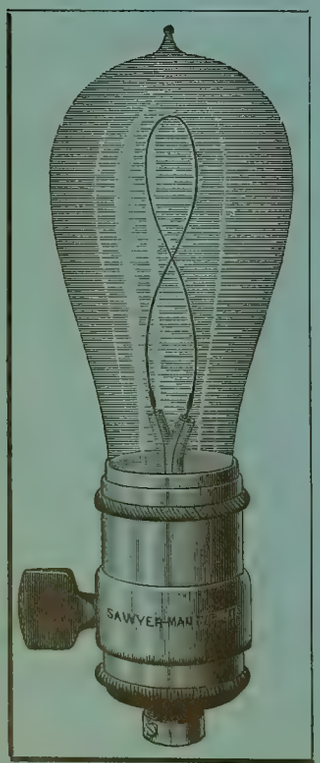
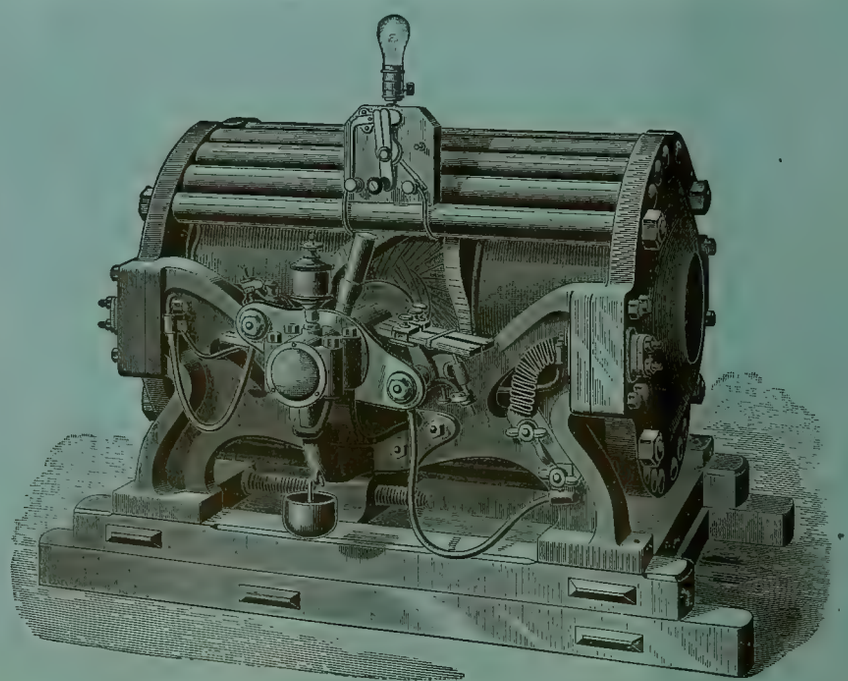
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





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Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

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Compensation Balance and Hair-spring,

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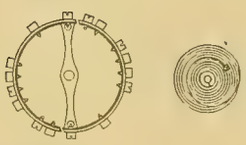

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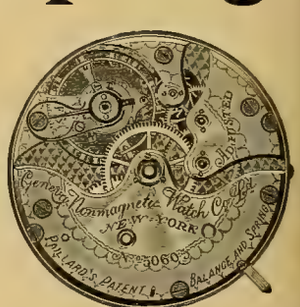

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The AMERICAN DYNAMO HAS NO EQUAL.

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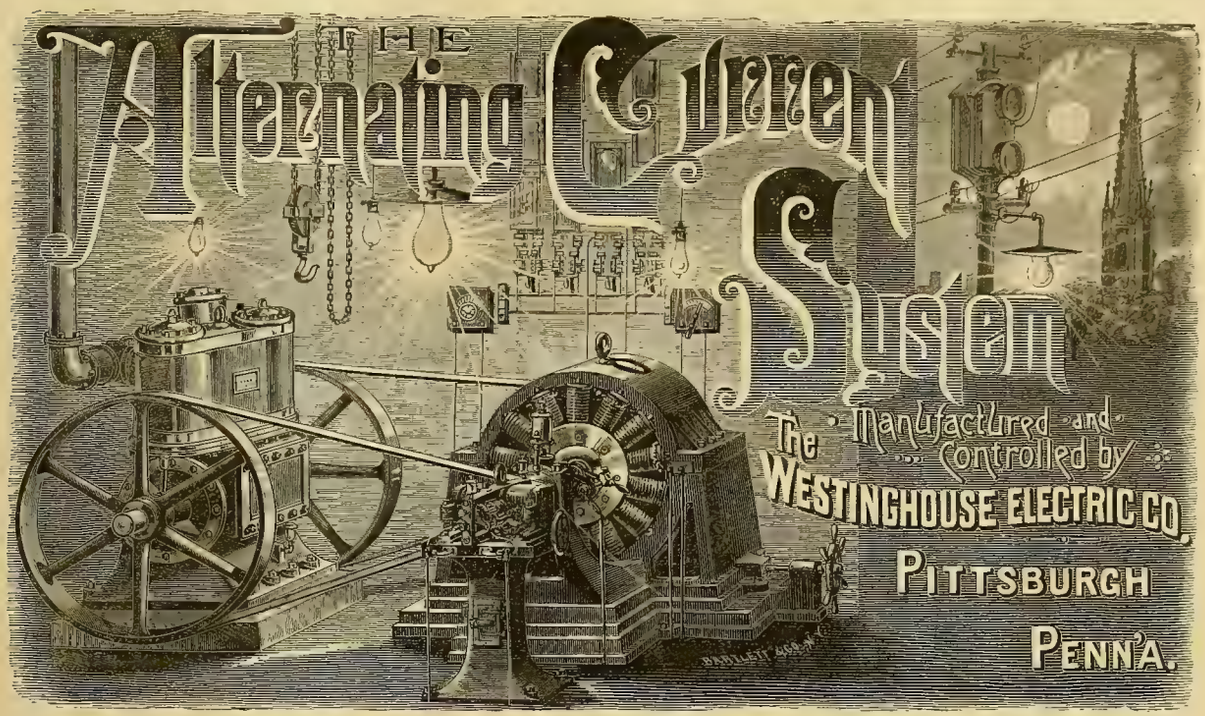

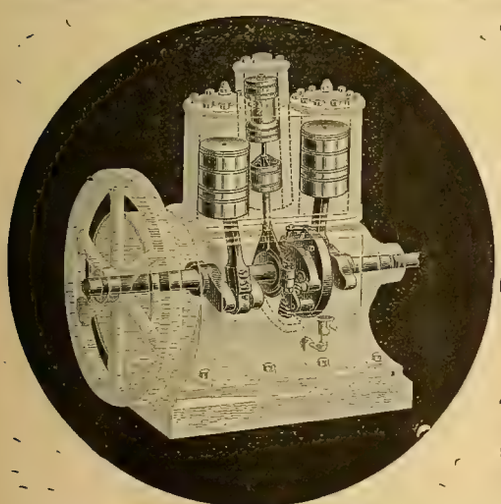

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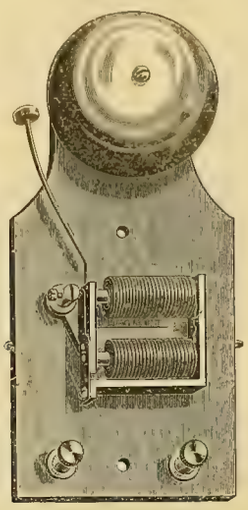

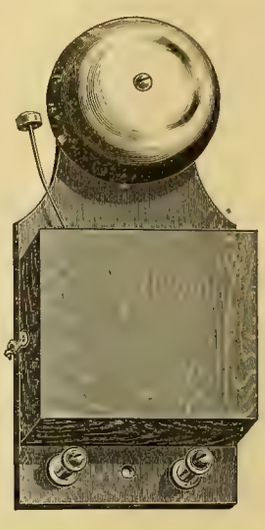

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EVERY SATURDAY

Vol. II. CHICAGO, MAY 26, 1888. No. 21.

Death of George M. Phelps, Sr.

George M. Phelps, sr., who has been identified with electrical progress in this country as a mechanician and inventor for over thirty years died at his home, 91 Division avenue, Brooklyn, E. D., May 18th, at the age of sixty-nine years. As superintendent of the factory of the American Telegraph company at Troy, he became prominently known as a most skillful mechanic and ingenious inventor, during the earliest days of printing telegraphy. Subsequently the factory was removed to New York, and Mr. Phelps remained its superintendent until the business was disposed of to the Western Electric company, when he assumed the duty of inspecting and supervising all the repairs and construction of electrical instruments in behalf of Western Union company. Meanwhile he had invented and improved various printing instruments, the most prominent being the celebrated motor printer, a model of electrical ingenuity and mechanical perfection. Indeed the high character of instrument construction under the carefully trained skill of Mr. Phelps, which became impressed upon his subordinates, was considered the standard for all work of that description. Mr. Phelps retired from active service four years ago, and although comparatively feeble in body maintained his mental faculties to the last.

Thus briefly does our New York correspondent convey an item of painful intelligence and give the salient features of the life of a man who has left a lasting impression upon the record of electrical progress.

Mr. Phelps was born at Watervliet, Albany county, New York, March 19, 1820. At an early age he entered the employ of his uncle in Troy, New York, who was engaged in the manufacture of mathematical instruments. In 1852, he became interested in telegraphic apparatus which at that time was attracting great attention. Between New York and Buffalo three telegraphic companies were operating under the Morse, Bain and House patents. Many of the House instruments had been constructed at the shop of Phelps & Dickerman, over which the subject of this sketch had the mechanical supervision. In 1856, the American Telegraph company purchased the entire establishment and placed Mr. Phelps in the position of superintendent. From this time forward the inventive skill and genius of Mr. Phelps had more scope as, relieved from financial cares, he could devote his whole time and attention to work to which he was so well adapted. The Hughes printing telegraph, patented by David E. Hughes, of Kentucky, in 1855, though embodying principles of value was more or less imperfect in details and the instrument was placed in Mr. Phelps' hands to perfect. This work largely consumed the years 1855 and 1856 and when completed resulted in a thoroughly effective and useful instrument. Mr. Phelps continued in the same branch of work and in 1859 completed and introduced the well-known Phelps' combination printer. This instrument has nobly stood the crucial test of time and has made a remarkable record. But remarkable as it is, the combination printer has been surpassed by the motor printer referred to in the opening paragraph. This printer was the fruit of many years of careful study and experiment. Reid in "The Telegraph in America" refers to a record the printer had made of sixty words a minute over a line of 500 miles and adds, "even this does not fully represent the capacity of the instrument which seems limited only by the ability of the fingers which manipulate it." Mr. Phelps' inventive ability was not confined wholly to the electrical field, for his name is known in connection with a wide range of improvements in time regulators, bank locks and paper making machinery, but his fame nevertheless rests upon his work in the electrical department of industry and particularly that branch relating to printing telegraphs. From 1856 until about four years ago Mr. Phelps was continuously in the employ of the American Telegraph company and its successor the Western Union Telegraph company.

Mr. Phelps' character was one that might well be emulated by younger inventors. Perseverance was a marked feature of his nature. His word, like his character, was cleanly cut. Perfection even to the smallest detail was his aim, and to Mr. Phelps' rigid adherence to the adage that what is worth doing is worth doing well, is due the high fame for perfect work intimated in the first paragraph of this sketch.

Mr. Phelps leaves a wife and two children.

GEORGE M. PHELPS, SR.

George M. Phelps, jr., editor of the *Electrical Engineer*, New York, is his son.

A Novel System of Laying Cables.

A Berlin correspondent writes that a novel system of laying underground cables has been adopted in the station at Lübeck which has a capacity of 2,000 lights. The method heretofore followed in Berlin and other towns consisted in the employment of either Edison tubes or Siemens lead covered cables, with an armature outside formed of spiral wound iron tape. To reduce the cost of the cables the iron armature has been omitted in the Lübeck cables, and the lead envelops is protected by a serving of jute heavily tarred. Since these cables are mechanically not so strong as those with an iron armature, they have been laid in flat channels of rolled iron with an iron lid. These channels are perforated at the bottom, so as to allow water which may find its way into them to pass out into the ground. Owing to the protection afforded by the iron channels, it has been found possible to lay the cables close under the paving stones. The junction, feeding and distributing boxes are also smaller and less expensive than those used in Berlin. They are provided with short sockets, into which the iron channels fit. At the bottom of the boxes a plate of ebonite is fixed, to which are secured the various terminals and connections for the fusible plugs. Another departure has been made in the testing wires. These do not form part of the main cable as in Berlin, but are separate cables brought back from the feeding centers to the station.

ANNUAL MEETING

OF THE

American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers, was held at the house of the American Society of Civil Engineers, 127 East 23rd street New York, on Tuesday May 15th, at 8:15 p.m. The business of the evening was opened by the presentation of Secretary Ralph W. Pope's report.

THE SECRETARY'S REPORT.

With the close of the fourth year of the existence of the institute, your secretary takes pleasure in announcing that the work for which it was organized has been still more actively entered upon since the last annual meeting, and with exceedingly gratifying results. Believing that its past record was of sufficient importance and interest to warrant more general support from all who were interested in electrical science, it was deemed proper that efforts should be made to enlist the aid of all who appreciated the value of such an organization. This policy has been beneficial in various ways. It has made known the existence of the institute, and gained for it a world-wide reputation. It has enlisted the support of new adherents, and stimulated the attachment of those who were previously associated with it. The additional revenue thus derived has enabled the council to carry out various plans for the general good, and increased the value of memberships to distant as well as local friends.

The plan of holding more frequent meetings, undertaken last year, has been continued more systematically, and all have been well attended. The value of the papers presented, and the discussions which followed, are familiar to all by reason of their monthly publication and distribution. The transactions of the institute have also been very generally printed by electrical journals at home and abroad. In order to add to the value of the institute's publications a classified index was begun in December of all articles of importance on electricity appearing in technical journals, published in the English language. This index is appended every month to the issue of the transactions. Some idea of its scope and of the work involved may be formed when it is stated that the index, during its first six months of compilation, has included under the various heads upwards of 2,500 distinct articles, for which have been given nearly 4,000 references, accompanied by over 500 explanatory and critical notes. The immediate appreciation of this work on every hand is a sufficient warrant and reward for its execution. Such an index, if existing to-day, of early periodical literature on electricity would be simply invaluable, as those who have occasion to make searches or are investigating in any branch can testify; and the secretary believes that by assuming the task at this time the institute will be found in a very few years to have done a work of inestimable importance. It is now proposed to extend the index so as to include all electrical books as they appear. The bibliography of electricity will then be rendered complete.

The institute has doubled its numerical strength since the last annual meeting, besides reclaiming a good percentage of original members who had become lukewarm in their support. The increased revenue has been devoted to such purposes as would result in satisfying every member that he was receiving a fair equivalent for his share of the amount expended.

The project of providing permanent quarters, which has been referred to in three previous annual reports, has been given careful consideration during the past year by the council and its committee, as well as by the officers individually. Although greater progress might have been made, at the risk of abandoning the more important work of the institute, it was deemed wise to continue for the present upon the line of policy which is now being pursued. The business affairs of the institute and its accumulating literature made it necessary, however, that office quarters should be secured, and a suitable room has been leased and furnished for this purpose in Temple court, 5 Beekman street.

The cordial relations which have existed since its organization between the institute and the American Society of Civil Engineers still continue, and the meetings of the institute will be held at the house of the latter, by courtesy of the board of managers, during the coming year, at the discretion of council.

There have been 182 associate members elected during the past year, of whom 166 have qualified by paying their entrance fees and annual dues. Four have resigned, one has died, one has dropped from the roll and one placed upon the suspended list. The total number of members and associates is 322, of whom 267 have paid up in full to date, seven are in arrears for the present year, twelve for two years, and thirty-six for three years. There has been an improvement in the delinquent list, by the collection of $387.50 during the year, but many of those who remain

upon it have lost all interest in the work of the institute. Others have met with financial difficulties which may yet be overcome.

The secretary takes pleasure in acknowledging the receipt of the following gifts from friends of the institute:

From Edward P. Thompson a carpet for the office of the institute.

From T. C. Martin $25 cash toward furnishing the same.

From Charles Colne a set of Patent office reports.

From the Consolidated Telegraph and Electrical Subway company, a bound volume of photographic views of the subways as constructed in New York city.

From Emile Berliner a working model of his "Molecularium."

From Wm. H. Sawyer, files of the London *Electrician*, London *Electrical Review* and the New York *Electrician* and *Electrical Engineer*.

Officers Elected.

The newly-elected officers are as follows:

President: Edward Weston.

Vice-presidents: Prof. Elihu Thomson, Francis R. Upton, and T. C. Martin.

Managers: Thomas D. Lockwood, George B. Prescott, jr., Wm. Maver, jr., and Charles Cuttriss.

Treasurer: George M. Phelps, jr.

Secretary: Ralph W. Pope.

Three vice presidents and four managers hold over from the old board. The new administration will have difficulty in surpassing the record of the past year in the growth of the institute, but will labor to at least maintain its past record for scientific electrical work. No other important business was transacted at the business meeting.

The general meeting for the presentation and discussion of papers was called to order at 10:30 a. m. May 16th, by Vice-president Martin.

The following papers were presented:

Underground Electrical Conductors in Europe and America.

BY PROF. G. W. PLYMPTON.

The problems of construction of underground systems of electrical conduction will have been solved when the telephone and the arc light systems are both buried under our streets without impairing the efficiency or durability of either.

By this I mean that all the difficulties encountered in burying conductors are involved in converting telephone and arc light from *aerial* to *underground* systems. Telegraph lines and systems of incandescent lighting present fewer difficulties in the process of burying, and none of a kind not met with in dealing with the systems first mentioned.

The telephone problem is substantially solved. Some details only remain to be settled, among which may be mentioned the best size of conductor, the most serviceable insulation and the maximum distance of effective service for either grounded or metallic circuits.

In Brooklyn the general plan adopted is that of a conduit divided into ducts through which cables containing from sixty to one hundred wires are drawn. The material of the conduit is for the most part creosoted wood. About ten miles of this is already in use in our city, and about four and a half miles of the Dorsett concrete conduit. For the extensions of the underground systems for the present year, only creosoted timber is to be used.

Among the lessons learned from our experience are: 1st. That in creosoted conduits the use of cables covered with kerite, or any similar rubber or gutta percha compound must be avoided. 2d. That in the so-called lead covered cables, the use of pure lead is also to be avoided, as it is slowly converted into a porous and friable lead carbonate. An alloy of lead with five or six per cent. of tin seems to resist the destructive action. 3d. That the conducting wire first used is too small for satisfactory telephone service. The difficulties of induction and retardation led to complaints as soon as 4,000 or 5,000 feet of underground wire was put in service. The cables that are now being put in are made up of wires whose cross section is greater by one-third than that of the first wire, and they are protected by twice the thickness of insulation.

I mention the above conclusions as having been drawn from our own experience in Brooklyn.

In beginning our work we gathered such information as could be gleaned from localities where solutions of the problem had already been attempted. The impression so largely prevailed that in Europe all telephone and telegraph conductors were underground that our board decided that a personal inspection of European systems should be made by one of our number. The duty devolved upon me. The result of my inquiry has been published in the scientific papers.

In regard to the burial of the arc light wires I can only say that no method yet tried seems certain of success. Most of them certainly insure the destruction of the underground conductors in from one to three years. But I have no doubt that a solution of the problem will soon be reached, although the system will be kept apart from the telephone and telegraph subway.

It does not seem likely that arc light conductors will be allowed in the same conduit with telephone wires, nor will they be distributed from the same manholes.

In saying that, I believe that a solution of the problem will soon be found. I do not mean to assert that casualties like that recently recorded of a man in the Bowery, who lost his life by grasping the naked wire close to an arc lamp, can be prevented by any system of burying wires. To prevent such *accidents*—if that is the term to be used—the arc lights must be buried with the wires.

All past experience teaches us to proceed cautiously. Nothing can now permanently check the growth of the telephone, the telegraph or the electric light. They have become necessities of our civilization, and any hasty or ill-advised enforcement of the law to convert all aerial to underground systems which should result in serious injury to them, would prove the surest way to perpetuate the nuisances of overhead wires and poles in the street.

Professor E. G. Nichols read the following paper:

A Swinging Arm Galvanometer.

BY GEORGE S. MOLER, A. B., M. E., CORNELL UNIVERSITY.

The objects sought in the construction of this galvanometer were applicability to a great range of currents, accuracy of indication and portability. In passing from the measurement of large to that of small currents no change in the apparatus is necessary, and still throughout a wide range great sensitiveness is maintained.

These ends are attained by making use of the fact that the influence of a current on the magnetic needle varies with change of distance and with the angle which the plane of the coil makes with the horizon. The principles of the sliding coil galvanometer and of Obach's cosine galvanometer are thus combined. A movable arm is hinged to the base of the galvanometer, Fig. 1, and carries the coil, which is attached to its outer end. The length of the arm is such that in the vertical plane the needle will be in the axis of the coil. By means of screw clamps, the hinges are made to produce friction enough to hold the arm in any required position.

When the coil is brought up into the vertical plane it is very near the needle, and a small current will produce a deflection. In this position, which is that of maximum sensitiveness—since the distance is a minimum and the angle which the coil makes with the horizontal plane is 90° $\frac{1}{100}$ of an ampere produces a deflection of about 8 mm.

As the arm is carried down towards the horizontal position, greater and greater currents must be employed to produce the same effect. The position of the coil can be read upon a graduated quadrant which passes through it, there being a pointer attached to the coil and extending inward to the graduations.

The arm consists of two parallel bars of copper, terminating in the two hinges. These are insulated from each other, and from them two flexible conductors are carried to

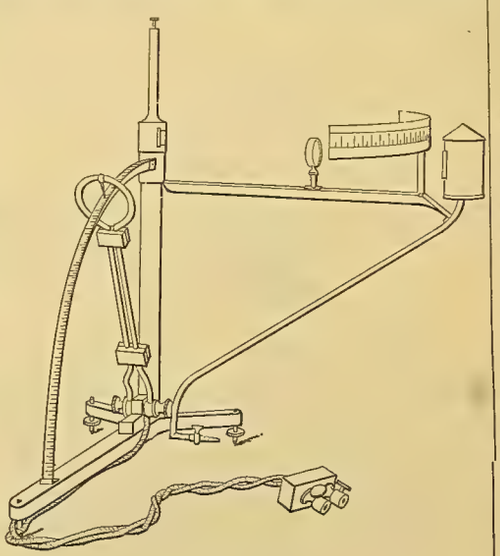

Fig. 1.—A Swinging Arm Galvanometer.

the extremity of the base; after that they are twisted together for a distance of about one meter and end in a block to which two large binding posts are attached.

The coil is made of a copper rod 8.5 mm. thick, and its outside diameter is 76.5 mm. The radius of the graduated quadrant is 343 mm., and it is divided into twentieths of an inch. The radius of the lamp scale is 381 mm. The scale forms the arc of a circle, having the galvanometer mirror for a centre. Its length is 500 mm., and it is composed of a paper rendered semi-transparent by being treated with castor oil.

The needle is shown in Fig. 2. It is a bell-shaped magnet carrying a mirror, which can be rotated slightly upon the suspension rod for the sake of adjustment.

The needle is suspended by means of a fine silk fiber, and is prevented from making a complete revolution by means of a stop. Its motions are dampened in the usual manner by the action of a surrounding cylinder of copper.

The rays of light from a small gas lamp, shown in Fig. 1, after passing through a lens, are reflected from the mirror and then fall upon the scale. When the plane of the swinging coil is in the magnetic meridian and no current is flowing, the spot of light will fall at the centre of the scale. The lamp and scale are attached rigidly to the body of the instrument for the sake of rigidity and to avoid the necessity of repeated calibrations. In the lamp case is a small circular opening having a fine vertical cross-hair of platinum, and the lens is so placed that the image of the cross-hair is sharply defined upon the scale. All parts of the scale being equally distant from the mirror, as shown in Fig. 1, the definition of this image is equally good for all deflections.

The swinging arm galvanometer is especially designed to be used with the method of constant deflections. By carrying the coil up from the horizontal position, the spot of light will be deflected more and more, until the image of the cross hair is made to coincide with the chosen mark upon the scale; the position of the coil is then to be read and the current found by reference to a calibration curve or chart. In the measurement of feeble currents, the chosen point on the lamp scale may be near the position of no deflection, while for stronger currents it may be further away. Several deflection points may be thus chosen and a calibration by means of some standard instrument can be made for each; then, to insure greater accuracy in the determination of a current, several of these points may be used, and the mean of the currents

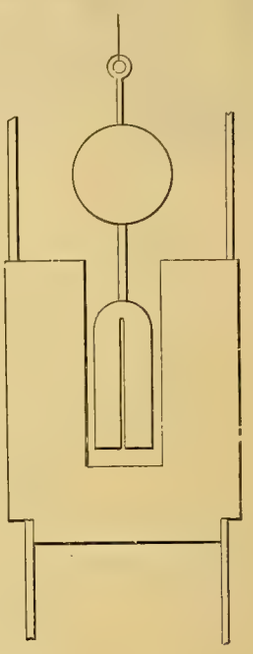

Fig. 2.—A Swinging Arm Galvanometer.

indicated by them may be taken, giving to each its proper weight.

The instrument may also be used by taking different fixed positions for the coil and reading the deflections of the spot of light, calibrating for each of these positions as before. These two methods may also be combined by moving the coil until the spot of light is approximately in coincidence with a selected deflection point, observing its distance from the same and applying to the current value, by means of the previously determined figure of merit, the proper correction. In this way changes in a slightly fluctuating current can be followed and measured by moving the coil.

In order to indicate heavy currents to an audience in a lecture room it is only necessary to remove the lamp-stand and scale and to make use of the stronger light of the magic lantern, the image of a slit in the field of the lantern, after reflection from the galvanometer mirror, being thrown upon a wall or screen. A position of the coil can then instantly be found which will produce suitable deflections for any given current, from a fraction of one ampère up to that which the coil and connections can be made to convey without destruction from heating.

In the curve, Fig. 3, and the accompanying table are given the results of a calibration of a galvanometer of the pattern just described, which has just been constructed in the Department of Physics in Cornell university.

The deflection selected was 10 cm, and the measurements, which extended from 3 ampères to 60 ampères, by no means covered the possible range of the instrument. The movement of the coil indeed covered only 200 of the 400 scale divisions into which the reading quadrant is divided.

The calibrations were made in the magnetic observatory of the university, in which locality the average value of the earth's horizontal intensity is .1713. The currents were measured upon the great tangent galvanometer.

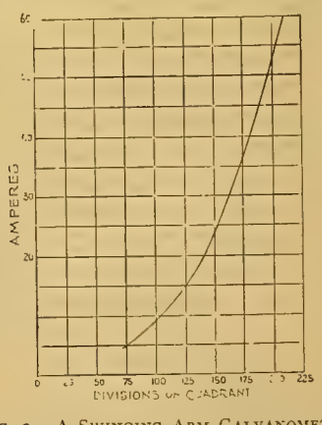

Fig. 3.—A Swinging Arm Galvanometer.

Simultaneous readings were made upon that instrument and upon the swinging arm galvanometer.

The readings of the great galvanometer, reduced to ampères, with the corresponding positions of the swinging coil for a deflection of 10 cm. are given in the following table:

CALIBRATION OF THE SWINGING ARM GALVANOMETER BETWEEN 5 AMPERES AND 60 AMPERES; CONSTANT DEFLECTION = 10 CM.

Current in amperes (large galvanometer).	Quadrant readings (swinging arm galvanometer).	Current in amperes (large galvanometer).	Quadrant readings (swinging arm galvanometer).
5.21	79.0	19.48	138.0
5.54	79.5	24.42	151.0
5.84	82.0	24.48	151.5
8.04	95.8	32.00	167,0
10.35	106.0	33.44	168.5
10.39	107.0	33.99	171.0
10.86	110.0	38.50	179.5
11.53	110.0	42.79	185.0
13.25	119.0	43.90	187.0
13.92	119.5	46.14	191.0
15.25	125.0	53.56	202.0
19.39	137.5	59.39	208.0

From these values, with the readings of the new galvanometer as abscissæ and currents in amperes as ordinates, the curve shown in Fig. 3 has been constructed.

From this curve the currents for intermediate positions of the coil may be determined and the degree of accuracy of which the instrument is capable may be estimated.

Compensated Resistance Standard.

BY EDWARD L. NICHOLS.

The electrician has few more troublesome corrections to make in the course of his measurements than those arising from the influence of temperature upon resistance. Were the heating of wires due solely to changes in the surrounding air, the matter would not be a serious one. Such changes could be reduced to a minimum by devices well known in the art of physical measurements, unavoidable changes could be determined by the aid of the thermometer, the temperature coefficient for the various elements of the circuit could be ascertained and proper corrections applied.

Since, however, heat is developed in every circuit in amount measured by the product of the current and the e. m. f. between the terminals, the temperature of a wire through which a current flows is always higher than the surrounding atmosphere. In the case of heavy currents the temperature of the wire may be very high indeed. The difficulty of applying corrections for temperature is such as to lead to frequent rejection of methods which would otherwise be of great convenience, and might lead to results of the highest accuracy.

The discovery of a substance, the resistance of which would not change perceptibly under the influence of heat, would, it goes without saying, be of great value. Unfortunately, all known metals are influenced in the same sense; nor has any alloy been found which is devoid of a temperature coefficient. The exhaustive investigations of the British association committee in this field are too well known to need recapitulation; and while some alloys have been recently produced which are much better than anything that committee was able to discover, even these forfeit much of their usefulness on account of their low conductivity.

One substance only, among the solid conductors of electricity, seems to offer a solution of the difficulty. Carbon, as has been shown by Matthiesen,[1] Siemens, and many later observers, differs from the metals in showing a decrease of resistance with rise of temperature. The amount of this change, which differs widely in the case of the various artificial carbons, is given in the following table:

TABLE I.

INFLUENCE OF TEMPERATURE UPON THE RESISTANCE OF VARIOUS VARIETIES OF CARBON.

Observer.	Variety of carbon.	Temperature interval.	Mean coefficient per deg.
Werner Siemens (*Wiedemann's Annalen*, 10, p. 560	Gas carbon	0 to 200°	.000345
	Pressed gas carbon	0 to 200°	.000301
Borgmann (*Journal der Russischen Physikalishen Gesellschaft*, 9, p. 163)	Charcoal	26 to 260°	.00370
	Anthracite	20 to 250°	.00265
	Graphite	25 to 250°	.00062
	Coke	26 to 245°	.00026
Keurlein (*Wiedemann's Annalen*, 12, p. 78)	Gas carbon (coarse)	18 to 200°	.000285
	Gas carbon (fine)	18 to 200°	.000287
	Carrè's carbons	18 to 200°	.000321
Murvaka (*Wiedemann's Annalen*, 13, p. 307)	Paris retort carbons		.000300
	Arc light carbons		.000405
	Arc light carbons		.000425
	Gaudoin's carbon's		.000415
	Kaiser & Schmidt's carbons		.000370
	Hellmann's carbons		.000246
	Arc light carbons		.000156
	Siberian graphite		.000739
	Faber's lead pencil graphite		.000588

The temperature coefficient, while varying widely for different carbons, is very nearly constant for a range of more than 100 degrees, in the case of any given specimen. It seemed probable, in view of this fact, that a conductor might be constructed by combining carbon with a metal in proper proportions, in which the influence of temperature upon the carbon and the metal respectively would precisely counterbalance each other, thus securing to the combination a constant resistance throughout a considerable range of temperature.

The calculation of the proportions necessary to this result, in the case of carbon, the coefficient of which has been determined, and a given metal, copper for example, is very simple.

1 Matthiesen, *Poggendorff's Annalen*, 115, p. 353.

Assuming that the combination would be subject to the law of parallel circuits, no alloy being formed, and no chemical combination between the parts taking place, we have for the total resistance R:

$$R = \frac{R_m R_c}{R_m + R_c},$$

where R_m is the resistance of the metal and R_c the resistance of the carbon.

The equation of condition, for complete compensation will be

$$\frac{R_m' R_c'}{R_m' + R_c'} = \frac{R_m'' R_c''}{R_m'' + R_c''}$$

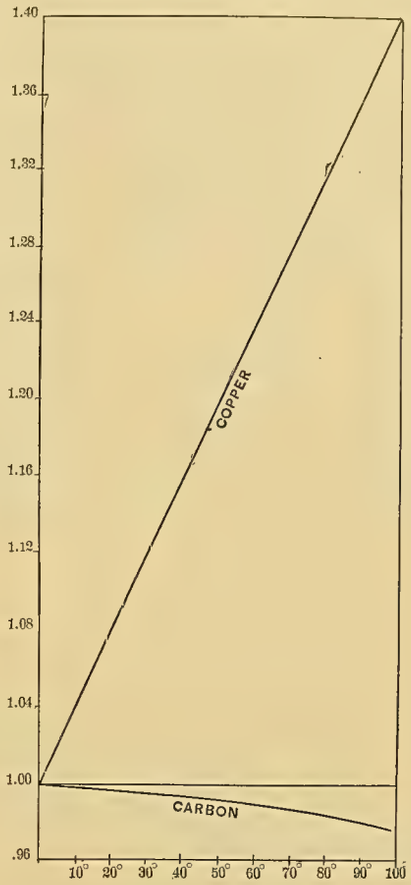

Fig. 1.—Compensated Resistance Standard.

where R_m'', R_c' are the resistances of the components and R_m'' R_c'', the corresponding resistances at any other temperature within the limits of temperature for which compensation exists.

Now the variation of the resistance of a metal with the temperature may be expressed by an equation of the form:

$$R_m'' = R_m' (1 + at \pm bt^2),$$

where a and b are coefficients to be determined by experiment.

In the case of carbon, the coefficient a will have a negative value, and the equation will take the following form:

$$R_c'' = R_c' (1 - at \pm bt^2).$$

Between 0° and 100° the value of b in the case both of copper and carbon is very small. A recent determination of the coefficients for copper, made in the physical laboratory of Cornell university, yielded the equation:

$$R_m'' = R_m' (1 + .00380\, t + .00000047\, t^2)$$

The experiments, which covered a range of 100°, are in close agreement with the results published by Matthiesen.

In the above equation, for $t = 100°$, we have $bt^2 = .0047$. If we neglect the coefficient b and adopt for a the mean coefficient between 0° and 100°, we may write the equation in the simpler form.

$$R_m'' = R_m' (1 + .003847t),$$

which will give no results agreeing with the complete form at 0° and 100° and will have a maximum error, at 50°, of .0008.

In the case of carbon the coefficient b may also be neglected without appreciable error.

A Carrè pencil, measured by another member of the same laboratory, gave as mean coefficient between 0° and 100°, the value .000235.

We may therefore write the equation for this variety of carbon, as follows:

$$R_c'' = R_c' (1 + .000235t).$$

The relative influence of heat upon the resistance of copper and carbon is shown graphically in Fig. 1, which diagram will also serve to indicate the nearly constant value of the temperature coefficient of those substances.

In combining copper and carbon in such proportions that the resulting resistance shall be independent of the temperature, the following equation of condition must be satisfied:

$$\frac{R_m' R_c'}{R_m' + R_c'} = \frac{R_m'' R_c''}{R_m'' + R_c''}$$

This equation will be satisfied only for a range of temperatures throughout, which $b^2 t$ is negligible, in the case of both substances.

For such a range of temperatures we have, however, as already indicated,

$$R_m'' = R_m' (1 + a_m t)$$
$$R_c'' = R_c' (1 - a_c t);$$

where a_c and a_m are the coefficients for carbon and copper respectively.

Within such limits

$$\frac{R_m' R_c'}{R_m' + R'} = \frac{R_m' (1 + a_m t) R_c' (1 - a_c t)}{R_m' (1 + a_m t) + R_c' (1 - a_c t)};$$

which is readily reducible to the form,

$$R_m' \left(\frac{a_c t}{1 - a_c t}\right) = R_c' \left(\frac{a_m t}{1 + a_m t}\right)$$

Using the coefficients already determined for copper and the variety of carbon in question, namely:

$a_m = .003847.$
$a_c = .000235.$

We find,

$R_m = 11.544\, R_c$

In a word, we must use, for every ohm of carbon, 11.544 ohms of copper in order to secure complete compensation of temperature.

Three methods of combining the copper and carbon in such a compensated resistance have occurred to me as likely to give a good result. The first method consists in wrapping an insulated wire, of the necessary resistance, around the carbon and soldering the ends to the terminals of the bar, previously copper plated for that purpose. The second method consists in mixing the proper amount of copper in a finely divided state with the paste of which the rod is to be made, and then molding and baking the carbon in the usual manner.

In the third method, which is the only one which I have as yet put to actual trial, the carbon, having been tested and its temperature coefficient determined, is electroplated with copper. Experience showed that the film of copper necessary to compensation was so thin as to be scarcely adherent. The following process was therefore submitted for that of coating the entire surface: A Carrè carbon 2.95 mm. in diameter was copper plated for about 5 mm. at each end. The ends were then amalgamated and placed in mercury cups, which formed the terminals of a Wheatstone bridge. The resistance of the rod having been measured, and its mean coefficient between 20 and 100° having been determined, the length necessary for a compensated resistance of one legal ohm was calculated. The rod was then cut to the proper length, allowing 5 mm. at each end for terminals. The ends were heavily plated, and were inserted into the ends of copper rods, which were carefully soldered to the carbon. The rod was then given a coat of shellac, and, when dry, a strip of the varnish was removed with a sharp knife. The strip laid bare was parallel to the axis of the rod, aad extended from terminal to terminal. Its width was about 1 mm. The rod was then submerged in a plating bath of sulphate of copper.

In this way a film of copper was deposited upon the exposed portion, which combined the required electrical resistance, 11.544 ohms, with sufficient thickness to render it tough and adherent. It was found that one gravity cell, acting through 50 ohms, would deposit the requisite amount of copper for a one ohm bar, in about ten minutes. When the above process has been carefully carried out, the rod was found to have very nearly the proper total resistance and to be nearly perfect in the matter of compensation. If the rod was over compensated, copper was removed by careful scraping. If it was under compensated carbon was removed by the same process. These final adjustments were continued until the rod showed no perceptible change of resistance when heated to 100°. When the compensation was regarded as satisfactory, the adjustment of total resistance was made by removing the copper plating of the terminals, or extending the same by renewed plating. This, if carefully done, would bring the rod to the proper resistance without impairing the compensation. The rod, after adjustment, was well varnished, and was inserted in a glass tube of about 7 mm. internal diameter. This tube was provided with brass caps, through which the copper terminals projected to a distance of about 5 cm. These, after being securely riveted to the brass caps, were bent through an angle of 90°. When thus mounted the resistance rod presented the appearance indicated in Fig. 2.

Fig. 2.—Compensated Resistance Standard.

In the manner just described, I succeeded after a few trials in producing a resistance rod upon which the influence of the temperature between 18° and 100° was entirely imperceptible. The object being to test the method of compensation, and not to produce a standard ohm, the adjustment for final resistance was not carried out.

The resistance of the compensated rod, after being mounted, is shown in table II.

For the purpose of this measurement, the rod was immersed in an oil bath and heated to more than 100°. The

readings were taken while the bath was cooling. They indicate a practically perfect compensation throughout the range of temperature given in the table.

If such a compensated resistance rod be quickly heated or cooled, the copper will change more promptly than the carbon and the balance will be temporarily destroyed. While in process of heating from without, the resistance will increase somewhat, and while cooling by radiation the reversed effect will be noticeable.

TABLE II.

RESISTANCE OF A COMPENSATED RESISTANCE ROD AT VARIOUS TEMPERATURES; MEASUREMENTS BY GEO. D. SHEPARDSON.

Temperatures.	Resistance in B. A. ohms.
105°C.	1.0300
98°	1.0300
87°	1.0305
35°	1.0305
22.5	1.0295
19°	1.0300

In rods not mounted in glass and unprotected by a coating of varnish these variations are very marked. Table III. contains a set of readings made upon such a rod. The rod was rapidly heated and cooled, and was measured several times during the rise and fall of temperature. The compensation was nearly complete, the mean coefficient between 20° and 100° being less than .00002, but the rod in question exhibited temporary variations when suddenly heated and cooled, amounting to more than 1 per cent.

TABLE III.

TEMPORARY VARIATIONS OF A COMPENSATED ROD SUBJECTED TO SUDDEN CHANGES OF TEMPERATURE.

Temp.	Resistance.	Temp.	Resistance.
25°	1.0050	78°	1.0030
(Gas ignited.)		(Gas extinguished.)	
37°	1.0072	78°	0.9965
45°	1.0074	74°	0.9960
55°	1.0070	63°	0 9975
62°	1.0040	40°	1.0030
68°	1.0040	25°	1.0050
70°	1.0040		

Compensated resistance bars, such as have been described in this paper, are of course limited in their application to uses in which carbon conductors are admissible. For standards of resistance I think they will be found especially valuable. The convenience of having a comparison resistance the value of which can be determined once for all, and which can then be used with confidence, without regard to its temperature, even in circuits which would heat our ordinary standard coils and modify their resistances to a notable extent, will be appreciated by all. In the construction of low resistance shunts, also, the possibility of obtaining a conductor which will remain unchanged at all ordinary temperatures, whether heated from without or by the passage of the current, will permit us to adopt with confidence the use of high resistance galvanometers, with low resistance shunts, for the measurement of large currents, even where the highest accuracy is necessary.

To those who, in the course of their electrical work, have to cope daily with the question of the influence of temperature upon resistance, numerous other applications of compensated resistance rods will suggest themselves.

The Possibilities and Limitations of Chemical Generators of Electricity.

BY FRANCIS B. CROCKER.

Electro-chemistry seems less generally and less clearly understood than any other branch of electricity of equal importance. The facts concerning the dynamo, motor, telegraph and telephone are widely and definitely known; but there are ideas, statements and claims in regard to batteries which are further from the truth, more prevalent and go longer without being contradicted than any other collection of errors that I can call to mind.

Primary batteries have not received the attention in this country that they have abroad, particularly in England, where the successful or unsuccessful attempt to float a new primary battery company is a matter of almost weekly occurrence. Nevertheless the subject is a sufficiently important one, and the false ideas of which I have spoken have spread so far beyond the quacks, to whom such ideas are usually confined, that the subject deserves more study than it usually receives, particularly from the scientific standpoint.

Electromotive Force.— The electromotive force which a given battery or combination of materials will develop is the first and most important question in electro-chemistry. Of course, the best and surest way to arrive at this e. m. f. is to determine it by actual experiment with a voltmeter, or, still better, by comparison with a standard cell. There are, however, many times when the materials or instruments are not at hand, and a calculation or predetermination of the e. m. f. is very convenient.

The formula for calculating the e. m. f. is obtained by assuming that the electrical energy of the given chemical combination is equal to the heat energy which the same combination is capable of producing, or $E\ C = 4.16\ C\ a\ H$, that is, volts multiplied by coulombs is equal to the coulombs multiplied by the electro-chemical equivalent, *i. e.*, the weight of material required per coulomb and that by the heat produced by one gramme of the material. Cancelling the C in both members, we have $E = 4.16\ aH$, in which E is the e. m. f. in volts, a is the electro-chemical equivalent (grammes per coulomb), and H is the number of heat units (gramme-degrees Cent.) produced per gramme, of material by the given chemical combination. The values of a and H are given for most materials in electrical and chemical books of reference, and the calculation is a very simple one, nevertheless this formula and the principle involved in it are not generally understood and are very seldom used. The equation deduced above is that ordinarily given, but what I have found to be a more convenient form of it is obtained by assuming that $E = I$, giving a its value for hydrogen (.00001035). Solving with respect to H we have $H = 23{,}300$, which means that 23,300 is the number of heat units per equivalent corresponding to one volt, and all that is necessary to find the volts of any given chemical combination is to divide the number of heat units per equivalent (which is the form they are almost always given in) by 23,300 and the quotient is the e m. f. in volts. For example, to obtain the e. m f. which zinc and free chlorine will develop divide 48,600 (which is the number of heat units produced by the combination of one equivalent of zinc with one of chlorine as given by Thomsen) by 23,300, and the result 2.09 is certainly very close to 2.11, the actual value obtained by experiment. In the same way the e. m. f. of other combinations of materials may be predetermined, but it should be always borne in mind that the heat of combination corresponding to one *equivalent* of the material should be taken and not necessarily that corresponding to one atom; as for example in the case of zinc, the heat per atom (65 grammes) is 97,200 which has to be divided by 2 to reduce it to one equivalent because zinc is a dyad and takes two atoms of chlorine, which is a monad. In the case of monad metals like sodium, potassium and silver the figures may be taken just as they are given in the tables. Mistakes very frequently arise in this way; in fact I do not think I ever saw a table of electro-chemical equivalents in which this point was correctly introduced in every case.

In order to test the practicability and accuracy of calculating e. m. f., as well as to obtain reliable results and full data for their own value, I determined the e. m. f given by thirteen of the most important metals in combination with free chlorine, bromine and iodine, and the results are given in tables A, B and C respectively. In table D, I have averaged these results and placed them side by side with the results obtained by calculation. The agreement between the two sets of figures is not perfect by any means, but when it is remembered how the e. m. f. of a cell will change one or two-tenths of a volt on apparently the slightest provocation, I think the figures are strikingly close, more so than I expected to find them. In more than half of the cases the difference is less than one-tenth of a volt, and the average difference is only slightly more than that. There has been no warping or coaxing of the figures to secure uniformity. The results are given just as they came. If figures were picked out from the different observations it would be possible to obtain almost perfect agreement between the calculated and determined, as one may see by looking over the tables.

In regard to the experimental results as given in tables A, B and C, I may state that all the metals and salts used were chemically pure, with the exception of the metals magnesium and aluminium, and these were of a very good quality. Pure carbon plates were used for the negative plate, but platinum was also tried and gave substantially the same results. The e. m. f. was measured by a Thompson reflecting galvanometer (by Elliott) using two independent standard Daniell cells. One fact which strikes one in looking over the tables A, B and C, is that the e. m f. is not very greatly affected by the solution; a certain metal gives about the same result in one chloride as in another, and the same is true of the bromides and iodides. In table E, I have given the e. m. f. obtained by substituting different metals for the zinc in a Daniell cell, but these results being from only one series of observations, are probably not so reliable as those in the preceding tables.

In the remaining table I have collected in condensed form the principal facts in regard to batteries in which zinc is used as the electro-positive material with the most important electro-negative or depolarizing materials. The facts in regard to metallic zinc, which hold good in all cases in which it is used (no matter what the other material is), are given on a horizontal line with zinc. Below this the facts in regard to each particular combination are given opposite the polarizer. For example, the data of a zinc and chlorine battery are given on a horizontal line with chlorine, of a zinc and nitric acid (Bunsen) battery on a line with nitric acid.

For convenience the table is divided into two parts: the left hand side contains the purely scientific data, and the right hand portion contains the practical facts.

In the first column of the first part is given the chemical symbols reduced to a common basis, any one of the expressions being chemically equivalent to any other. For example, one-half atom of zinc (½ Zn) requires one atom of chlorine (Cl), or one-half atom of oxygen (½O), or one-third molecule of chromic acid ($\frac{1}{3}Cr_2O_3$), or one-sixth of the mixture of one molecule of potassium bichromate and seven molecules of sulphuric acid ($\frac{1}{6}[K_2Cr_2O_7 + 7H_2SO_4]$), and so on.

In the second column are given the chemical equivalents which are simply the proportions by weight required by the different materials. That is, when we use 32.5 grammes (hydrogen being assumed as one gramme), we require 35.5 grammes of chlorine, or 33.4 grammes of chromic acid, and so on.

The third column contains the electro-chemical equivalents, which are really exactly the same and directly proportional to the combining weights in the previous column, but are reduced to an electric basis of so many milligrammes per coulomb. To convert these figures into grammes per ampère hour simply multiply by 3.6.

In the first column of the second part of the table is given the e. m. f. of each combination, all of which with the exception of oxygen, sulphur and water, are determined by experiment, most of them being well known and accepted values. In the case of oxygen, sulphur and water the e. m. f. is calculated as explained above and is merely given for comparison. No actual battery corresponding to these materials exists.

In the second column, on the right hand side, is given the number of pounds of zinc required per horse power hour in the case of each combination. For example a zinc and copper sulphate (Daniell) battery, requires 1.86 pounds of zinc per horse-power hour of electrical energy produced.

In the next column I give the weight of depolarizer required per horse-power hour in the case of each combination. For example, a battery requires 5.05 pounds of the mixture of three parts of potassium bichromate, and seven parts of sulphuric acid, which is about the ordinary strong bichromate solution for porous cell batteries. Of course the water required for the solution is not considered here or in any of the other figures of the tables, because it costs nothing and serves merely as a medium of electrical action; but if the total weight of solution is desired, the weight of water must be added.

The weight of the different materials consumed per ampère hour is given in the next column. These figures are obtained directly from the electro-chemical equivalents in the third column by dividing by 125; in fact, they are simply the electro-chemical equivalents in pounds per ampère hour

It should always be carefully noted that the weight consumed per ampère hour is that required in *each cell* in *series*, whereas in the case of horse power hours the weight given in the table is the total weight used, no matter how many cells there are or how they are arranged.

In the next to the last column is given the wholesale cost per pound of the different materials. These prices are of course very difficult to fix, because they depend upon the market and vary greatly upon the quantities bought; but the prices I have here are very low and ordinary consumers would have to pay twice as much in most cases; they give, however, some idea of costs.

In the last column I have given the cost of both materials, zinc and depolarizer, added together. I have not here considered the values of the products, because it is very difficult to estimate the cost of collecting and utilizing residues. In the case of silver chloride the silver resulting from the action would, of course, be worth a large portion of the cost of the original chloride.

One of the interesting points which this table shows is the total weight required per horsepower hour. For example, .95 pound of zinc and 1.04 pounds of chlorine, making a total of almost exactly 2 pounds, would produce one horsepower of current for one hour if all of the chemical energy could be converted into electric energy.

This brings up the question of how large a percentage of the chemical energy can be utilized, or, in other words, the efficiency of chemical generators. This efficiency is

TABLE A.

E. M. F. produced by different Metals in Combinations with Free Chlorine in Solutions of —,

	Magnesium Chloride.	Zinc Chloride.	Zinc Chloride.	Zinc Chloride.	Hydro-Chloric Acid.	Common Salt.	Average.
Magnesium	2.83 2.65	2.65			3.2–3.15	2.85	3.1
Zinc	2	2.20	2.13	2.11	2.20	2.18	2.11
Cadmium		1.94		1.86	1.98	1.93	1.9
Aluminium	1.75	2.04	1.88		2.02	1.98	2.
Iron		1.60	1.56	1.5	1.67	1.68	1.6
Cobalt		1 43	1.43	1.41	1.50	1.45	1.43
Nickel		1.33		1.27	1.40	1.33	1.33
Tin	1.50	1.70	1.6	1.57	1.68	1.66	1.61
Lead		1.63	1.62	1.60	1 68	1.65	1.63
Copper		1.31	1.30	1.29	1.37	1.34	1.32
Silver		1.11	1.12	1.13	1.15	1.10	1.11
Antimony		1.20	1.23	1.25	1.25	1.08	1.22
Bismuth		1.29	1.25	1.20	1.27	1.19	1.21

TABLE B.

E. M. F. of different Metals with Free Bromine in solutions of

	Magnes. Bromide.	Nickel Bromide.	Potass. Bromide.	Hydro-Bromic Acid.	Magnes. Br'mide weak.	Average
Magnesium	2.55	2.45	2.51	2.7	2.57	2.56
Zinc	1.84	1.78	1.82	1.79	1.85	1.79
Cadmium	1.6	1.54	1.62	1.57	1.61	1.58
Aluminium	1.5	1.46	1.47	1.46	1.6	1.53
Iron	1.22	1.25	1.31	1.26	1.33	1.3
Cobalt	1 1	1.02	1.05	1.06	1.13	1.05
Nickel	.8	.85–.8	.8	.87	.94	.85
Tin	1.12	1.31	1.3	1.25	1.27	1.3
Lead	1.4	1.27	1.33	1.28		1.33
Copper	1.05	.96	1.01	.99	1.03	1.02
Silver	.97	.94	.97	.95	.93	.95
Antimony	.99	.73	.71	.87	.97	.8
Bismuth	.92	9	.96	.88	.92	.92

higher, I think, than it is generally supposed to be. I have no exact figures upon this point, but I have tested several times the weight of zinc consumed compared with the theoretical amount, and I have found that even in a plunge battery, where the bichromate solution was directly in contact with the zinc and the opportunity for local action was a maximum, that the zinc efficiency was as high as 75 per cent. and in one case 80 per cent. In a porous cell battery with amalgamated zinc, where there was little or no cause for local action, I believe the zinc efficiency would be as high as 90 per cent. and I should not be surprised to find it as high as 96 or 97 per cent.

TABLE C.

E. M. F. of different Metals with free Iodine in solutions of —,

	Magnes. Iodide.	Zinc Iodide.	Potass. Iodide.	Average
Magnesium	2.02		2.00	2.01
Zinc	1.35	1.23	1.29	1.25
Cadmium	1.12	1.12	1.13	1.12
Aluminium	.92	.83	.87	.88
Iron	.69	.6	.74	.68
Cobalt	.6	.42	.5	.51
Nickel		.35	.37	.36
Tin		.72	.69	.71
Lead		.82	.85	.83
Copper	.63	.67	.62	.64
Silver	.65	.67	.64	.65
Antimony	.41	.47	.46	.44
Bismuth	39	.46	.42	.43

TABLE D.

Comparison of the E. M. F. Calculated from the Heat of Combination and the E. M. F. determined by experiment.

Metals.	Combining with Chl'rine Calc.	Determ.	Bromine Calc.	Determ.	Iodine Calc.	Determ
Magnesium	3.24	3.1				
Zinc	2.09	2.11	1.68	1.79	1.05	1.25
Cadmium	2.	1.9	1.58	1 58	.97	1.12
Aluminium	2.3	2.	1.7	1.53	1.00	.88
Iron	1.75	1.6	1.5	1.3	.85	.68
Cobalt	1.64	1.43				
Nickel	1.57	1.33				
Tin	1.71	1.61	1.5	1 3		
Lead	1.76	1.63	1.38	1.33	.85	.83
Copper	1.4	1.32	1.07	1 02	.69	.64
Silver	1.25	1.11	.97	.95	.59	.65
Antimony	1.3	1 22				
Bismuth	1.3	1.21				

The efficiency of the depolarizer is generally lower than that of zinc, because there is generally a good deal of chemical energy left in the solution after it is too weak for satisfactory work. The efficiency of the bichromate solution in the plunge battery I have just referred to was only about 45 per cent. of the total theoretical power. But this is very low, because the solution has to be weak in acid on account of being used in contact with zinc. In the case of a copper sulphate battery, where the crystals of sulphate are often almost entirely used up, I think the efficiency would be as high as 80 or 90 per cent.

The efficiency I speak of here is simply the *chemical* efficiency in the battery; the fall of potential in the battery due to its internal resistance compared to the external is another loss which has to be added to the chemical loss in determining the total efficiency. The possibilities of chemical generators are therefore almost infinite, since it requires theoretically a total of only 2 pounds of zinc and chlorine, and two pounds of zinc and chromic acid per horse-power hour, and since the efficiency of batteries can casily be made as high as 75 per cent. it follows that less than three pounds of material is actually required per horse power hour; but unfortunately the water for the solution, the containing vessel, electrodes, etc., are so heavy that the total weight is very many times greater. The possible and the actual battery are thus very far apart. If we use metals of higher chemical affinity and e. m. f. than zinc the theoretical weight of material required is even less: only one pound total of chlorine and magnesium are required per horse-power hour, with metallic sodium and free chlorine having a calculated e. m. f. of 4 volts it would only take about .8 pound per horse-power.

The easiest and best solution of the problem, however, does not seem to be the use of more powerful metals than zinc. The latter is powerful enough; it only takes, as we have seen, about one pound of it per horse power hour with nitric acid, chromic acid or bichromate solution, and less than two pounds with copper sulphate. The opportunity for improvement seems to lie more in the direction of perfecting the general form of batteries. The apparatus is at fault, not the chemical action. Moreover, zinc is about as high on the electro-positive scale as it is safe to go so long as water is present. Even in the case of zinc its affinity for oxygen is greater than that of hydrogen, it is therefore only by tolerance, so to speak, that zinc remains passive in the presence of water. If it is not properly amalgamated, or if the solution is too strong, local action does occur. If, in place, of zinc, we use any more electro-positive metal these troubles are aggravated; with magnesium, for example, there are only very few solutions in which it will stand without great local action. Metals of still higher power, such as sodium, can not be used at all in presence of water. Jablochkoff has, I believe, made cells in which sodium is used with damp cloth, but this can hardly be considered as water.

TABLE E.

E. M. F. produced by different Metals substituted for the Zinc in a Daniels cell.

Metals.	Volts.	Metals.	Volts.
Zinc	1.08	Lead	.58
Cadmium	.79	Copper	.07
Aluminium	.65	Silver	—.02
Iron	.64	Antimony	.09
Cobalt	.49	Bismuth	.17
Nickel	.1		

The proper way to use metals of great chemical energy would seem to be with liquids which do not contain any oxygen, but unfortunately such solutions are not generally good conductors. Another possible plan is to employ a fused electrolyte, but this involves the serious difficulty of maintaining it in the fused state.

So far as I can see zinc is a very satisfactory positive material for batteries. After all it is cheaper than any metal except iron. It is a sufficiently good conductor and less dirty and liable to corrosion than almost any other metal; it is also, as I have just shown, about as high on the electro-positive list as it is safe to go.

The electro-negative materials on the other hand leave far more to be desired. They are generally expensive, very troublesome to handle, and introduce that quality of simple dirtiness, to whi h no other name can be applied, and which is really the most serious objection to batteries. The electro-negatives will, however, do the work, and as we have seen it actually requires very little weight to give a great deal of power, if the materials could only be used in a more perfect manner than at present. That seems to be the thing to hope for. Another serious difficulty with batteries is their high internal resistance. A dynamo can easily be made to give 100 volts with a thousandth or a few ten thousandths of an ohm internal resistance, hence their great output; but a battery capable of giving 100 volts with only one thousand ohm internal resistance would probably fill this house.

In this connection it will be interesting to consider how many cells of ordinary gravity battery are required to give one horse power of current. Each cell will give one volt and not more than half an ampere under normal conditions, hence each cell furnishes half a watt or about 1,500 cells to the horse power! These cells would, however, give that power for a long time. But the fact remains that that very large number is required to produce the power which a dynamo not much larger than one's hat will generate.

In conclusion, I would say that I am by no means a skeptic in regard to chemical generators of electricity; the possibilities are very, very great, as I have shown. But these possibilities do not seem to have been brought to reality in a very perfect manner as yet. But batteries, even in the imperfect state in which they exist to-day, have their useful and legitimate function. A Leclanché cell is exceedingly well adapted to ringing electric bells intermittently and to telephone work, and gravity batteries have long done good service for telegraphic purposes.

But when it comes to developing any considerable amount of actual power, then the limitations become apparent. When we remember that battery electricity will certainly cost in practice 50 cents per horse power hour, since the materials alone cost 25 cents, and that dynamo electricity only costs 2 cents per horse power hour, the claims of some primary battery electric lighting promoters show up in their true light. As a luxury, of course, it makes very little difference what it costs, but even then people soon tire of paying very high prices for that kind of a luxury. For small electric lighting and small power in special cases batteries are useful, particularly where no other source of current is available. A physician or dentist to whom a horse power hour may be worth hundreds of dollars could almost afford to use a chloride of silver battery and throw away the silver.

SYMBOLS. — Chemical expressions reduced to a common basis.	CHEMICAL EQUIVALENTS. — Proportions in which materials combine. H = 1.	ELECTRO-CHEMICAL EQUIVALENT. — Weight of material consumed per amp. sec. milligrams per coulomb.	NAME OF MATERIALS.	Electro-motive Force produced. Volts.	Weight of zinc consumed per Horse Power hour. Pounds.	Weight of Depolarizer consumed per Horse Power hour. Pounds.	Weight of Materials consumed per amp hour in each cell. Pounds.	Cost of Materials wholesale. Per Pound.	Total Cost of both positive and negative materials per Horse Power hour.
½ Zn	32.5	.337	Metallic Zinc,				.0027	$.07	
+			used with following electronegative or depolarizing elements:						
I	127.	1.314	Free Iodine	1.2	1.67	6.53	.0105	3.50	$22.97
Br	80.	.828	Free Bromine	1.79	1.12	2.76	.0066	.38	1.12
Cl	35.5	.367	Free Chlorine	2.11	.95	1.04	.0029		
½ O	8.	.083	Free Oxygen*	1.9	1.05	.26	.00066		
½ S	16.	.166	Free Sulphur*	.95	2.1	1.03	.0013	.02	.17
			CHEMICAL COMPOUNDS.						
½ H_2O	9.	.093	Water *	.5	4.	1.1	.00074		
HNO_3	63.	.652	Nitric Acid	1.9	1.05	2.04	.0052	.06	.20
⅓ CrO_4	33.4	.346	Chromic Acid	2.	1.	1.03	.0027	.20	.28
½ $CuSO_4$	79.7	.826	Copper Sulphate (anhyd.)	1.079	1.86	4.55	.0065		
½ $CuSO_4 \cdot 5H_2O$	124.7	1.29	Copper Sulphate (Crystals)	1.079	1.86	7.13	.0102	.06	.56
½ Fe_2Cl_6	162.5	1.683	Iron Perchloride	1.55	1.3	6.5	.0133	.10	.74
Ag Cl	143.5	1.487	Silver Chloride	1.06	1.89	8 32	.0118	16.00	133.25
½ Hg_2SO_4	248.	2.57	Mercury Sulphate	1.42	1.41	10.7	.0204	.50	5.45
			MIXTURES.					Mixture per lb.	
⅛ { $K_2Cr_2O_7$ / $7H_2SO_4$ }	163.5	1.694	{ Potass. bichrom, 3 pts. / Sulphuric acid, 7 parts }	2.	1.	5.03	.0133	.04	.27
⅓ { $K_2Cr_2O_7$ / $4H_2SO_4$ }	229.	2.37	{ Potass. bichrom., 3 pts / Sulphuric acid, 4 parts }	2.	1.	7.04	.0186	.05	.42

* Calculated.

(*Continued on page* 263.)

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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EASTERN OFFICE, 30 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

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Notice to Subscribers.

Subscriptions to the WESTERN ELECTRICIAN, weekly, at $3 per annum and *The Electrical Engineer*, of New York, monthly, at $3 per annum now filled from this office at $5 per annum for both journals.

THE Chicago North Side cable has not yet settled down to business, but continues to break down at busy hours of the day.

THERE is something interesting in the proceedings of the American Institute reported in this issue for every person concerned in electrical matters. There are papers technical and papers popular, papers theoretical and papers practical.

THOSE whose connection with electric lighting causes them to appreciate the dangerous character of electric currents, will read with interest the paper of Patrick B. Delany, who modestly refers to his invention for the protection of the human body.

THE Chicago common council had several questions relating to illumination to deal with at the last meeting, but the aldermen were so wrought up over the saloon question that all other questions were postponed to a more convenient season.

THE Chicago West side street car company proposes to introduce the cable system on Madison street. This is doubtless a change for the better, but the announcement is a disappointment to many who have been urging the adopting of an electric system.

GEORGE S. MOLER'S contribution to the annual meeting of the American Institute of Electrical Engineers, describing a swinging arm galvanometer applicable to a great range of currents, yet highly sensitive throughout, accurate in indication, and withal possessing the feature of portability, is very interesting, and exhibits a sound scientific knowledge on the part of the writer and constructor. The instrument presents many novel features which will commend themselves to careful study,

MR. CROCKER'S paper on "The possibilities and limitations of chemical generators of electricity" is a very careful analysis of the subject in hand, and his conclusions are directly to the point. He states that he is by no means a skeptic in regard to chemical generators of electricity, for the possibilities are very great; but the limitations are apparent when it comes to developing any considerable amount of power, for battery electricity will certainly cost in practice 50 cents per horse power hour, while dynamo electricity costs only two cents per horse power hour.

IN his paper, presented at the meeting of the American Institute of Electrical Engineers, George H. Stockbridge shows clearly the lack of uniformity which has prevailed in the Patent office practice. As a remedy for this evil he strongly commended the bills recently presented to Congress by the legal committee of the National Electric Light association. The arguments which the committee advanced in favor of its plan are emphasized by Mr. Stockbridge, and he asserts if the plan is adopted that uniformity would be secured by reason of the fact that changes in the commissionership of the Patent office would not be so frequent.

AT the last meeting of the Chicago Electric club, Elmer A. Sperry read an instructive paper on "Motors and alternating currents." Mr. Sperry was called upon to treat this subject at the eleventh hour, as the gentleman who had been expected to present the paper was prevented at almost the last moment from filling the engagement. The subject of Mr. Sperry was timely and was right in a line with the discussion now in progress before the club. He was confident that motors would be constructed which could be operated by alternating currents. He realized that difficulties were in the way, but as many of the ablest electricians were devoting careful study to the problem he looked for a happy solution.

IN his address before the recent convention of the Western Gas association, the president, Emerson McMillin, made a number of interesting and significant statements. In comparing the gas engine and the electric motor he said the latter was the more convenient and the former the more economical. He predicted a struggle between these rivals, and prophesied that the small steam engine would be discarded. He said the sentiment among gas companies relative to the advisability of furnishing electric light had changed in the last year. He said a very large percentage of the corporations were in favor of this course. He predicted an increased use of arc and incandescent lights, and said it was not the province of the manufacturer to dictate what kind of light the consumer should use, but should furnish the illuminant the purchaser chose to employ.

PROF. G. W. PLYMPTON presented a brief paper on the question of underground electrical conductors, at the meeting of the American Institute of Electrical Engineers, but though his remarks were few the author concisely states information of great interest to those who are face to face with a serious problem. The question of burying the telephone wires has been substantially solved, the professor says; only matters of detail now require study. The arc light problem has not been solved, Professor Plympton says, but he is hopeful, and predicts a solution which shall be satisfactory. He also makes a statement which may well be borne in mind by those who urge the immediate burying of wires before satisfactory means for accomplishing the purpose are discovered. If hasty, unreasonable measures force electric light companies to bury their wires, such action may perpetuate the overhead wires, for the reason that the public demands the arc light as a necessity. If underground systems, forced inconsiderately upon companies, should prove unsuccessful, public opinion would tolerate the overhead wires. This is an argument for conservatism which is too often forgotten.

IN the death of his father, George W. Phelps, Jr., editor of our esteemed contemporary the *Electrical Engineer* of New York, has suffered an irreparable loss. Condolence is at best of little service in assuaging grief, but we tender an assurance of heartfelt sympathy, with the knowledge that it is shared by a host of friends.

Proud fame rests upon the record of the dead. His character was clean cut and was exemplified in his work. His genius was marked and his inventive talent universally recognized. He was an inventor, and he closely applied his abilities to the work before him. Too often every duty is sacrificed to give inventive ability scope, and many an inventor has left the unenviable reputation of being naught but a genius. But coupled with Mr. Phelps' great ability to originate was good common sense, and a realization that he owed something to others than himself. He was essentially a home man, if the phrase be allowed, and enjoyed the companionship of his family to the fullest extent. The financial fruits of his prolonged career were carefully garnered, and those dependent on him will enjoy them.

IN New York on Tuesday last counsel argued in the general term the question whether the American Bell Telephone company was liable for taxes upon its capital invested in the state and also upon its gross earnings. The counsel for the people urged that the corporation was legally bound to pay taxes at the rate of five-tenths of 1 per cent on its gross earnings, and penalties for non-payment to the amount of $6,941, making a total claim of $34,478. He quoted the various statute upon which the demand is based, and claimed that in them the right of the people to maintain the action was clearly established. He said that during 1886 it was conceded that 57,000 telephones had been employed in the state. During all the years of its existence the company had received an immense revenue from the rental of these telephones, and various commissions amounting to $110,000 in 1882 and $300,000 in 1886. He brought out the fact that the company went so far as to grant to the Western Union Telegraph company the sole right to receive telegraph messages sent over a telephone. James C. Carter, on behalf of the telephone company, held that the legislature had no right to impose upon a foreign corporation such a tax. The court took the papers and reserved its decision.

COMMENTING on that interesting subject, the attitude of gas companies toward electric light, the London *Electrical Engineer* says: "There is a grand opportunity now, though year by year this opportunity will slip away, and the gas companies, instead of guiding and controlling, will find their power for good or for evil entirely vanished. * * * The change is coming; it is as certain as that the world exists. The luxurious — those who can well afford luxuries — are quietly but quickly replacing the old methods of illumination by the new. They do not affect oil; they invariably replace what went before by means of the far better, purer, and intenser light evolved by electricity. This is as it should be. The light is a luxury; but, like other luxuries, as the demand increases it becomes cheaper, and so gets within the reach of a greater and a greater number, till ultimately what originally was a luxury, and nothing but a luxury, becomes a necessity, and is to be found in every house. * * * The moral we have to point out is, that directors of gas companies are missing the grandest opportunity of the century in not throwing themselves heartily into the work of developing the electric light industry. They are in a position which, rightly used, would give them almost as complete a monopoly of the one system as they have of the other. Their advantages are great. They have generally spare ground. They have a good deal of spare waste heat. They have a cheap fuel in the shape of coke. They have the opportunity of breaking up streets in many instances without danger of troubles arising with the local authorities."

(*Continued from Page* 261.)

The Patent Court and Uniformity in Patent Practice.

BY GEORGE H. STOCKBRIDGE.

In December, 1885, Mr. Montgomery, then commissioner of patents, rendered a decision in which he held that a process and a product, or any two "kindred and auxiliary" inventions, might be claimed in the same application. This decision was a reversal of his predecessor's judgment in *ex parte* Blythe (C. D. 1885, page 82). Whereas Mr. Butterworth had held that by employing the language, "art, machine, manufacture, or composition of matter," Congress had defined in the law itself certain distinct classes of invention. Mr. Montgomery denies this, in effect, and holds as follows: "Inventions may be distinct and not separate and independent; even if so distinct, if they depend upon each other and mutually contribute to produce a single result, if they are 'kindred and auxiliary,' if they are in their nature or operation connected together, if they are connected in their design and operation, they may be claimed in one patent."

The office practice under Butterworth has been to deny the right of inventors to claim a process and a product or a machine and a product, or a machine and a process (for these groups have always stood on the same footing) in the same application. The Blythe decision did not go so far as to warrant this in direct language, but it was given that scope by the office.

Now, when the Montgomery decision in the case of Young was published, all this was changed. This decision also was interpreted somewhat differently from what its language would justify, but it led to the practice of combining in a single application duplicate sets of claims on the lines indicated. This practice continued nearly two years. During that time applicants and their attorneys filed, we will say, a thousand cases having claims based upon the Young decision. This was done with the clearest warrant, which was the office interpretation of *ex parte* Young.

On Oct. 19, 1887, Mr. Hall, the present commissioner of patents, took up the same subject and rendered a decision *ex parte* Herr (41 O. G., page 463), in which he says: "It must be regarded as settled by the very highest authority that an apparatus and a process are separate and distinct inventions. There is no requirement of law that they must or ought to be comprehended in a single patent, while there are many reasons why they ought not to be. A claim for a machine or apparatus and a claim for a process should be prosecuted in separate applications, and each, when allowed, should be comprehended in a single patent." There was no mistaking the meaning of this language The result of it was that attorneys were notified, in the thousand cases I have mentioned, that the claims, or some of them, which they had filed in good faith and in accordance with the practice of the office, must be stricken out.

A secondary result was that inventors began to ask what their attorneys meant. "You told us," they said, "that we could cover both sets of claims by a single patent. What do you mean, now? Is this an attempt to squeeze us for another fee?" Well, of course, we had to explain. But the inventors then asked, "What does the *Office* mean? Is it possible that after fifty years no settled practice on this point has become established?" We had to answer, No. And in answering my own clients, I was led to consider just how safely such a statement might be made, and the result was the present paper.

Commissioner Hall expresses it in this way: "I approach the consideration of such a question with the greatest hesitation. It is one that has kept the attention of the office from its foundation up to the present day, and during the entire period there have been constant changes and variations of opinion on the part of commissioners, contrariety of decisions and diversified rules."

I have not seen fit to go back farther than eighteen years, during which time there have been eleven commissioners of patents, and four or five acting-commissioners during the interegna. In 1870 Mr. Commissioner Fisher made a decision in case of William Lowe (C. D. 1870, page 39). In this case the inventor, who had been allowed claims for an apparatus, sought to obtain a second patent upon the process which was conducted through his apparatus. In deciding the case on appeal, Commissioner Fisher said: "The first answer to this claim is, that it cannot form a subject of a separate patent. It is not a distinct and separate part of the thing patented in the original. The farthest to which the division of inventions has been pushed has been to grant one patent for the process and another for the product of that process. Such patents have, with some hesitation, been sustained (Goodyear *vs.* Honsinger, 3 Fisher, 150; Goodyear *vs.* Wait, 3 Fisher, 244; Goodyear *vs.* Providence Rubber company, 2 Fisher, 510), but upon the express ground that this was a matter confided by law to the discretion of the commissioner. But I have never known one patent to issue for the machine and another for the law and principle by which it operates. The mechanism of application is of no possible value except to carry out this process. Aside from this it possesses no patentable utility. The process is of no avail unless carried on through the medium of instrumentality. (Morton *vs.* New York Eye Infirmary, 2 Fisher, 324) It would be idle to sell the patent for mechanism and withold that which covers its legitimate and only mode of operation. Separate patents for processes and products have been justified upon the ground that the product might be imported, and a patent for the process would give no protection; but the machine and its mode of operation cannot be separated."

Mr. Fisher was a man of very positive opinions and he leaves no doubt regarding his views on the subject. But the views of his immediate successor, Mr. Leggett, are very different from his. (See Murray *vs.* Wuterich, C. D. 1873, page 96.) He draws diametrically opposite conclusions from Judge Clifford's decision in Goodyear *vs.* Providence Rubber company. Admitting that the office practice allowed a "machine and its products to be claimed in the same application and go out in the same patent," he sums up as follows: "Notwithstanding the precedents which exist, and admitting that such a practice as they indicate, if not strictly correct, is not fatal to the validity of patents, I think the time has come, when, leaving out of consideration the perspicuity of the patents themselves, and the revenue to be derived under the law for examinations, a proper classification in the office, so as to facilitate examinations and prevent mistakes in the issue of patents, requires that processes, machines and their products be presented for patent in separate applications."

Mr. Leggett resigned his office in October, 1874, and on the 23d of that month Acting-Commissioner Thatcher, in the case of Chamberlin (C. D. 1874, page 111) says: "All that can rightfully be claimed in this application is the machine and the link blank, which is the product of the machine." Here is plain evidence of difference of opinion. Mr. Thatcher evidently knows nothing about "a proper classification in the office, requiring that processes, machines and their products be presented for patent in separate applications."

I find no positive judgment of Thatcher on the subject, nor of the successor, Mr. Duell, although Duell deals with a case in which process and product claims are combined (Loeser, C. D., 1876, page 104) without adverse comment.

The next decision is that of Doolittle acting commissioner in 1877, in which he demands a division of the application of Junker and Wolf, on the ground that 'the article is not necessarily the result or product of the action of the machine." This is in some sense a forerunner of Commissioner Spear's decision in 1878, which introduced a mode of treating such cases which prevailed for several years after him. His language is: "No rule of universal application can be given for this class of cases, more than for any other; but in each case, as it comes up for consideration, the inquiry must be made whether the process or machine and the products thereof are so separate and distinct that they must be called independent inventions."

This doctrine was affirmed by Mr. Paine in various decisions, notably in Winterlich and others, where he uses this language: "If the machine and the manufacture are so related that the former cannot operate without producing the latter and the latter can only be produced by the former, both may be united in one one patent; but this is an exception to the general rule, which forbids the joinder of the machine and its product in one application.

Commissioner Marble, in Bancroft and Thorn (20 O. G., page 1894), applauds the doctrine of his immediate predecessor and lets each case stand upon its own merits. Then came the Butterworth decision to which I have already alluded. He regards art, machine, manufacture and composition of matter as "statutory classes of invention." "Suppose," he adds, "there be invented something in an art, or, as it is ordinarily called, a process, also a machine for carrying out the process, and also the manufacture or article which is produced in the operation of the process by the machine. There can be no doubt but that the statute calls for three patents for these three things. It makes no difference if they are invented simultaneously or successively, by one man or by three. Their independence remains the same."

Now let us see what changes of practice have been introduced by the various decisions to which reference has been made.

Mr. Fisher's decision seems to have been a new departure and to have altered the previous practice of the office. At all events, it fixed the practice under his administration and made it a positive requirement to combine claims for a machine and its product in the same application.

Well, what happens next? Mr. Leggett demands that such claim shall be separated, to facilitate the work of examination. That is change No. 2.

Mr. Thatcher and Mr. Duell appear to have allowed the two sets of claims to be combined, though I find no decision of theirs directly on the point. If I judge rightly of their practice, it may be regarded as constituting change No. 3.

It is certain that Mr. Spear and his successors, Mr. Paine and Mr. Marble, followed the practice of settling each case according to its own circumstances. Call this change No. 4.

Mr. Butterworth returned, in effect, to the practice of Mr. Leggett (change No. 5); Mr. Montgomery, in effect, followed Fisher (change No. 6), and Mr. Hall has now brought back the Leggett decision, thus introducing again a different practice from that of his predecessor in office (change No. 7).

I believe that if each commissioner had made himself the author of a new practice, there would have been three more changes than have actually taken place. However, I do not think more could have been expected. Really, this is very serious matter. The amount of annoyance and hardship imposed upon inventors in the way of unnecessary delay and expense is in the aggregate very great. I have no disposition to express an opinion as to which one, or whether any one, of the commissioners has been right in his judgment on the matter in question. I have no doubt that the decisions in every case have beendrawn up with a conscientious regard to the responsibility of the office from which the decisions emanated. But I do think that inventors and all who are interested in inventions have a right to protest against the continuance of a system which admits of and invites such unjust and arduous practices. It would not matter so much what the practice was, provided it were uniform, although of course it ought to be right and fair to inventors. But without uniformity it is monstrously unjust.

Lest it be thought that I have selected a peculiar class of cases, I may hasten to deny it in advance and may add that the office practice has been frequently altered on many matters quite as important. Take, for example, the question whether more than a single claim may be made in an application for a patent on a composition of matter. At least two commissioners have answered No, and at least two more have answered Yes. And so with many other cases. The mere fact that appeals have been taken to successive commissions on the same subject indicate the condition of affairs in the office.

What is the remedy for this evident evil? The best remedy yet proposed I conceive to be embodied in the bills recently laid before congress by the Legal committee of the National Electric Light association. One of these bills provides that the salary of the commissioner of patents shall be $8,000 a year. I am not sure that the enactment of such a bill would not do away with two-thirds of the evils of the present state of affairs. It is probable at least that we should not have eleven commissioners of patents in eighteen years, if the salary were $8,000, and with less frequent changes in the head of the office there would be necessarily less frequent changes in the office practice.

But there is still greater promise in the other bill which provides for the establishment of a Court of Patent appeals, which shall have appellate jurisdiction from the commissioner of patents "in all cases touching patentability of inventions, priority of invention among several claimants for patent on the same invention, and the *judicial practice of the Patent office*."

Such a court would be in the nature of the case a continuing body and its decisions would be little liable to change. The enactment of the last clause quoted would give it authority and set up what has never been set up before in connection with the Patent office—a controlling and continuing authority, governing the actions of the commissioner and, through him, of the primary examiners.

Protection of the Human Body from Dangerous Currents.

BY PATRICK B. DELANY.

Since the object of reading a paper before this society should be the enlightenment of members on the subject under consideration, by the presentation of facts developed by experimentation or of theories supported by a reasonable amount of investigation, I must apologize for my delinquency in both respects, and trust to the kind indulgence of the society in making a few suggestions, with a view of eliciting information and opinions from those whose experience and familiarity with the subject enable them to speak with authority.

I allude to what are considered dangerous currents, and their effect on the human body. That there is danger in handling conductors conveying high tension currents must be generally admitted. The question, therefore, is, can fatal results from such currents be wholly or partially averted? All will agree that with proper care on the part of the companies and intelligent coöperation on the part of employés, but little would be heard of the danger of electric currents. But companies are economical and employés are careless. Familiarity with danger breeds contempt for it. This is exemplified almost daily in every department of industry. A new man in a powder mill will exercise the greatest care, and observe all the rules of the establishment faithfully. In a few months the same man will smoke a pipe over an open powder keg.

Protection is necessary principally for those who, through carelessness or ignorance, fail to protect themselves. It has been claimed that there can be no such thing as an accident—that nature has none, and that all so-called accidents are simply the results of miscalculation, bad judgment or careles ness. But it must be remembered that the vigilance of the most alert will sometimes relax, and this to them is the moment of danger.

Realizing that something should be done to protect dynamo men and wire handlers from injury from powerful currents, I invented a device a few years since for shunting the vital parts of the body. Partly on account of a pressure of business in other branches of electricity, but principally owing to a hesitancy in bringing out a device about the efficacy of which there seemed to be some doubt, its introduction to scientific criticism was delayed until a few weeks ago. As the references made to the question in the electrical papers have failed to elicit an expression of opinion satisfactory to any degree, it has been deemed advisable to bring the subject before this meeting.

The question to be determined is, to what extent a wire of practically no resistance, extending from one wrist to the other and bound around the wrists in numerous convolutions, so as to make good but not uncomfortable contact, will protect the vital parts of the body from fatal injury when it is placed in the path of a dangerous current through contact at the hands. It is claimed by some that the current having once entered the muscles, veins and tissue at the hands, will not leave the arms at the wrists and follow the shorter path of the wire, but will confine its course to the arms and body alone. The other opinion is that the greater portion of the current received at the hands will leave the arms at the wrists and follow the wire. The problem seems a difficult one to solve. So much depends on the condition of the person at the time of receiving a shock, a large number of tests would be necessary to arrive at results which would afford a safe basis for calculation. A few years ago Dr. Stone, connected with one of the London hospitals, made a series of interesting experiments upon patients afflicted with various ailments, with a view of determining whether or not fluctuation in their physical condition affected the electrical conductivity or resistance of their bodies. The results proved, according to my recollection, that great changes took place in the electrical resistance of the patients experimented upon from day to day, and that there was a direct influence manifested by the rise and fall of different diseases upon the electrical conductivity of the body as a whole or in part. An account of Dr. Stone's experiments was published in *Nature* at the time. But while the experiments were most valuable for the purpose for which they were intended, they throw but little light on the subject of dangerous currents and protection from fatal injury.

Last September there was published in the *Electrical Review* of London a paper on "Shocks from alternating currents," by G. L. Addenbrooke, who for some time previous had charge of the Grosvenor gallery installation, where a primary current of 2,500 volts was constantly employed. While no one had ever come in contact with

both mains at once, the writer stated that even if such an accident had happened he was "by no means prepared to assert that the result would undoubtedly be fatal." "Indeed," says he, "I rather incline to the opinion that if the subject of the shock were healthy, and the circumstances under which he received it were favorable, the chances are he would survive."

I cannot make out what Mr. Addenbrooke means by receiving 2,500 volts under favorable circumstances. It seems to me, if they are received at all, the circumstance could not be other than unfavorable. Mr. Addenbrooke himself received a severe shock, and as he speaks from experience, I quote his account of how it affected him: "The primary effect of the passage of the current through the body is, of course, to contract the muscles. The amount and persistence of this contraction depend on the quantity of the current flowing, or, as it is usually designated, *the intensity* of the shock, and varies from a simple twitching of the limbs to complete and intense contraction or rigor of apparently every muscle in the body. In this latter case, the current completely supersedes the action of the mind over everything capable of contraction or movement. Consciousness, however, is apparently rarely, if ever, lost, though the subject may be entirely unable to make any motion, cry out, or do anything to help himself. If aid is not near, such a state may be maintained for some time. On release from such a position by extraneous or natural causes, the subject is usually dazed, but if at all unconscious, soon recovers completely and experiences no further functional disturbance than the debility and nervousness naturally following such a severe strain on the system." While admitting that fatal shocks are possible, this gentleman gives it as his opinion that "if the shock is not sufficient to cause instantaneous collapse, apparently the body can bear the strain of the continued passage of the current for some time," and that death is caused by paralysis of the involuntary muscles controlling the heart and lungs, and that the preliminary stages of total collapse are analagous to what occurs when drowning." Referring to the local action of the current on the body where it enters and leaves, this writer also says: "If the contact is good, that is, if it consists of a good area, say of over a couple of square inches of a fairly moist skin pressed with moderate firmness against a metallic body or other good conductor, no visible injury may result. For instance, a man will often get burnt about the hands, but his feet, by which the current leaves, will be unaffected, or only slightly reddened or inflamed. Burning of the hands or other parts of the body will occur when there is imperfect contact of the body with the conductor, coming in contact with a bad or semi-conductor, such as a dirty or carbonized surface. The burning is caused by the absolute setting up of an arc."

It seems to me this gentleman's views, based, as we are led to believe, on actual experience, are somewhat paradoxical. And surely numerous cases of deaths from currents recently disprove many of Mr. Addenbrooke's deductions. True, nothing short of death is made public, so that there is but little information to go upon relating to the instances which must be of frequent occurrence where men are *almost* killed by electric shocks. In all cases that have come to light, whether simply injuries or cases of death, the parts of the body coming in contact with the current have been badly burned. The unfortunate "Trouble Hunter," who lost his life a few days since, was not only burned at the hands but at the knees. In cases where the shock is not instantly fatal, may it not be that the burning of the flesh at the points of contact is so great as to destroy to a considerable extent the conducting substance in contact with the wire, and thereby cause a fall in the current passing through the body? It is certainly owing to the fact of the body being a very poor conductor that harm is done. If it offered no resistance there would be no realization that a current was passing through it. An arc would be created at the point of contact, provided the contact was *imperfect*, but the body itself would be un injured. It seems to me that the human body must be viewed as any other semi-conductor, with the exception, perhaps, of susceptibility to greater change under the continued action of a current owing to the fluids which it contains. It is owing to its resistance that a carbon filament becomes incandescent.

The carbon rod of an electric lamp is not consumed except at the point where the arc is formed by the resistance of attenuated particles under combustion. Any conducting substance placed in the path of more current than it is capable of conveying must be heated, consumed or decomposed, according to their nature and in proportion to the discrepancy between the conducting capacity of the conductor and the sum of the current.

Now if we liken the human body from hand to hand to a canvas hose or tube filled with water and which allows a certain quantity of moisture to ooze through the surface, corresponding to the moisture of the skin, and if this be inserted in a circuit, connection being made at the extreme ends, corresponding to the hands, and a shunt wire of minimum resistance be wound around the tube two or three inches from the ends, corresponding say to the wrists, we can, perhaps, more understandingly speculate on the action of a dangerous current on the human body, contact being made at the hands and the shunt wire encircling the wrists. It should be borne in mind that the contact between the shunt wire and wrists is much better than the contact at the hands, since the wrists are more tender than the hands. Now referring to the tube, and assuming that the contacts at the ends have improved by reason of the current eating its way into the water, does it not follow that the current instead of following the entire length of the tube of water, offering, say thirty times the resistance of the two or three inches of water from the end of the tube to the shunt wire, and several thousand times the resistance of the shunt wire itself, will, to a great extent, pass from the tube to the shunt wire, and in its passage improve the contact at that point as it did at the ends in entering the tube? I have often noticed that upon receiving a shock of 150 to 250 volts profuse perspiration instantly followed. This would greatly improve the contact at the wrists above the normal, so that it would seem impossible that the current should confine itself to the fluids and muscles of the body in preference to the wire when separated from the wire only by thin, tender skin filled with moisture.

In considering the danger point of currents it seems reasonable to recognize the same law, or rather recognize the absence of any law, governing other destructive agencies. Let it be concussion, strain, asphyxia, poison, or other enemy of endurance, there are hardly two cases alike. One man may emerge with but slight injury from a cause which to another man would be death. Why should it not be so in the matter of electric shock? Death, of course, must be the consequence of a certain degree of cause. If 2,000 volts are necessary to kill in any instance, one volt less would avert death, while shunting 100 or 500 volts would leave a proportionate margin of safety. Fatal results through the medium of electricity do not come by jumps any more than by any other force or element of destruction. There is in this subtle agency, as in all others, a last straw which breaks the camel's back—a last volt which does the final harm. Hence the importance of protecting, as far as possible, those exposed to this danger.

Regarding the immediate cause of death or the effect of currents on the substances of the body, we must look to the medical men for light. Probably all subjected to shock might not be similarly affected. In one case it might be the heart, in another the brain, and in others the lungs that might be injured. Why not have a thorough investigation of this subject, and then perhaps wire handlers may be subjected to an examination before they are allowed to engage in such work, just as men are examined for various other duties.

There seems to be so little known about these matters, I shall feel gratified if this paper serves as even a feeble incitement to discussion and investigation, as I can conceive of no subject offering a more humane incentive.

Motors and Alternating Currents.[1]

By Elmer A. Sperry.

There is probably no field of electrical engineering in which there is a greater activity at the present time than that of the alternating current motor, and were the investigations to be given to the public much interesting litera-

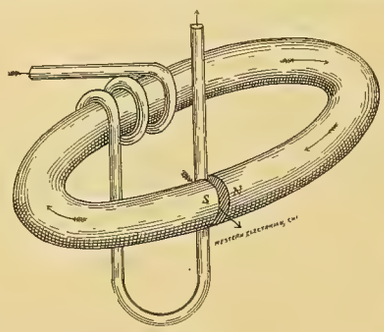


Fig. 1.

ture would be added to our present very limited stock in this line. It is known that one at least of the number of concerns in this country manufacturing alternating current apparatus is at present interested in an exhaustive series of experiments on the application of motor to the alternating current. For obvious reasons the results of these experiments are not available to the public, and our knowledge on the practical side of the solution of this problem is limited. A hurried examination of the subject, however, will reveal some facts which may be useful in a proper comprehension of the magnitude of the problem and something of the difficulties to be overcome. As to the advantages of a successful alternating current motor the fo lowing may not be out of place at this point since the question may arise, do the results to be achieved justify the expenditure of any considerable amount of time or money upon the problem? The facts have been mentioned in papers recently read before this club that during a greater portion of each day a large part of the total plant capacity is idle when the plant is used solely for the purpose of electric lighting. In stations where motors can be supplied at times when there is little or no demand for light such supply is evidently a clear gain. Such distribution of power bringing clearly an additional income, it can be economically distributed at a lower rate than the consumer can produce it himself, therefore it is not only an advantage to a corporation furnishing such power but to the community in which such station is located.

The demand for any article of manufacture is always greatly influenced by the fact that the means of utilizing that article are already at hand. For instance, any considerable demand for the gas engine is limited to the extent of the distribution of the gas system. Alternating currents are found already widely distributed in this country and therefore the means are at hand for utilizing the alternating current motor were it in the market, and that there is a demand is not a point in question. To look a little further into the abstract application of the alternating current it may be pointed out that certain restrictions are placed upon the use of the electric current by such recognized authorities as municipalities, board of underwriters, etc. These are very much more favorable to low potentials than to high. Labor can be employed and better attendants can be secured about machinery in which the element of danger is not considered of much magnitude. The distribution of large quantities of power will be practically limited to the alternating system, especially where these quantities are distributed for any particular distance, because in the alternating current we have the means of conveying a large amount of energy with a small loss to a distance, and then rendering it comparatively harmless to life and property before it is admitted to those portions of the system, or to any apparatus which requires manual attendants. As to the matter of special applications one case may be pointed out in particular which illustrates the flexibility of the alternating current system as used in the transmission of electrical power which would be almost impossible with any other system. It is well known first that the use of overhead conductors for conveying currents for locomotion, such as street cars, is open to serious objections especially in the streets of large cities, and secondly, that the only practical means of conveying currents to such cars is through underground conductors. To economically transmit sufficient energy for the large number of cars required on the ordinary city railways, the conductors must necessarily have a very great difference of potential besides being very heavy and expensive. It has been shown repeatedly that small potential underground conductors are perfectly practicable for street railways and that the leaks through the damp conduit and supporting insulators are not sufficient to render the system uneconomical; but when the potential is increased the leaks become of a serious character and render the system wholly impracticable, so

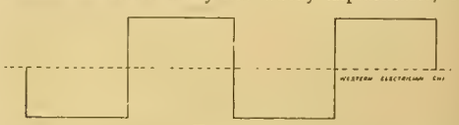


Fig. 2.

much so in fact that it has been thought better even for each car to carry about with it two or three tons of storage battery for the purpose of supplying its own current, the disadvantages of which are apparent and in which system the element of deterioration and wear and tear has as yet not been fully determined and are elements against which the manufacturer is not willing to guarantee. Suppose a system of electrical traction to be placed within underground conduits having a slot similar to the cable systems which are in operation in this city; suppose further, that two bare copper rods be supported suitably in such conduit for contact with the traveling terminals connected with the car. The ordinary direct system would charge these conductors from the central station direct giving them as low a difference of potential as is consistent with the cost per running foot which in case of the transfer of a large amount of energy to any considerable distance would be excessive in the extreme. The leakage between these conductors and consequent lowering of the efficiency of the system, together with the electrolytic action and consequent deterioration are elements of vital importance. Compare with this a system where these bare copper conductors are cut up in separate sections and are made the secondary terminals of transformers located in manholes at intervals, the primaries of which are run independently of the bare conductors in the same conduit or tunnel. First, the conductors, both insulated and bare, may be very small and correspondingly inexpensive both as to first cost and as to manner of supporting; secondly, the difference of potential of the bare conductors may be so small that the loss of energy from leakage may be entirely eliminated; thirdly, the well known absence of electrolytic action in the case of the alternating current will offer additional advantages in this as in any other place where moisture can not be avoided. The success of transformers in damp places has been demonstrated in the case of buried converters now in use in the Hoosac tunnel with which you are probably familiar.

That this system of transmission of energy will be less expensive as to installation, including the transformers, and more economical as to wastage of current, can not be denied. It being in every way pre-eminently adapted to the purpose, if in connection with this system of distribution an economical motor can be successfully operated.

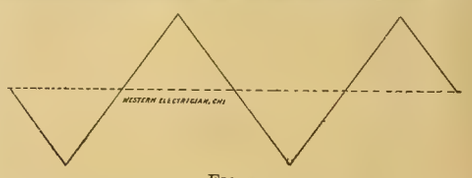


Fig 3.

The electric motor with direct currents to-day stands at the head of means of obtaining mechanical energy from energy in other forms, and near the other extreme of the list stands the heat or steam engine which is the most employed of all motors at the present day. Between these extremes may be noted the turbine, the gas engine and the wind motor. If we look into the method of operation of the electric motor we will find the fact of the *intersection* of two circuits, somewhat in contra-distinction to the *interlacing* of the same two circuits, namely the magnetic and electric, in the case of transformers. If lines of force in a magnetic circuit are cut or intersected by a current in an electrical circuit, the tendency to motion or mechanical effort results; now it is a very significant fact in connection with this subject, that the direction of this mechanical effort or tendency to motion remains unchanged if both of the factors producing it be simultaneously reversed, and the number of such changes or reversals in a given time produces no effect upon the mechanical tendency other things being equal. A simple illustration is shown in Fig. 1, in which a separate magnetic ring forming the magnetic circuit of a motor is shown energized by three convolutions of a conductor and which also passes through the opening in the magnetic circuit. If the current is in the direction indicated by the arrows, the tendency to motion

[1] Read before the Chicago Electric Club May 21, 1888. The sixth of a series of papers upon the subject, "The Continuous Current vs. the Alternating Current," before the Club.

will be in direction of the arrows protruding from the slot; if the current should be reversed, the direction of the induction will also be reversed and the direction of the motion would remain unchanged.

It is stated that a solenoid will make the same pull upon its core with a given expenditure of electrical energy, independent of whether such energy is in the form of an alternating or direct current, providing the core is sufficiently finely divided. An ordinary electric motor will start up and give out power with the alternating current if the periodic time of the alternation be not too small; but since the particular advantage of the alternating current consists in the use of the transformer and the efficiency of such a transformer is dependent upon a very small periodic time of the alternation, the problem becomes a complicated one, and other elements must be investigated to ascertain the true condition of economical operation. The above statement holds true for the motor of ordinary construction even with the rapidly alternating current, providing its cores be properly laminated to eliminate loss of energy in heating them.

This lamination offers little or no objection in point of construction. There are, however, other forms of alternating current motors, some of which will not start themselves, others which require to be run at some particular speed dependent upon a multiple of the periodic time of the alternation, and others which require a third circuit of constant current to maintain their magnetic field of force. These motors are open to this serious objection, that if the load be increased a very slight extent beyond their capacity, they will be thrown out of synchronism and will stop entirely. These forms of motors have received attention up to the present time and have been considered the most available forms. In this paper our attention will be more particularly directed to the first form, which is considered to be the most practicable, everything considered.

If the alternating current which is used to drive the motor of the first class should be one in which the reversal is instantaneous, or after each reversal or alternation has been wrought it will continue to flow with approximate uniformity until the next alternation, there will be no trouble in its application to the motor. This may be illustrated by the sketch shown in Fig. 2, wherein the time element may be figured along the dotted line, and inasmuch as the reversals are indicated by lines which are perpendicular to the line indicating the time element, such reversals take up no time in and of themselves and are therefore instantaneous. But such a current cannot be used in the transformers for the reason that secondary current is only produced through the changes which the primary undergoes; these may be shown by diagram, Fig. 3, in which the reversal is indicated by the oblique lines which meet and therefore consume all the time. This would be the

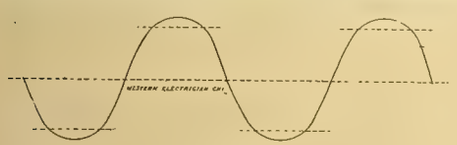


FIG. 4.

ideal alternating current for the purpose of the transformer. It will be seen from this that a compromise of these two must be obtained for the best results in power transmission, and when this is found it will not differ materially from the sine curve illustrated in Fig. 4. Here while the greater portion of the reversal is somewhat more instantaneous than in Fig. 3, still there is a period of time indicated above and below the extra dotted lines in which the current approximates uniformity which combines the advantages of the two foregoing in the best possible way. It is possible that in the near future, owing to the great number of possible combinations of alternating current phases, a third element will be introduced, produced by a separate winding upon the armature of the alternating current generator so that the two current phases taken from the transformers can be successfully applied in a perfectly economical manner to the operation of motors. In the case of the ordinary alternating current an extraordinary element is met with in the matter of retardation which under certain conditions gives us an algebraic sum approaching zero of the energies circulating at different instants of time during the period of one complete alternation of the electromotive force. This is produced in the following manner and is known as the result of self-induction which exists in the case of circulating an alternating current about an iron core. This fact of self induction has often been illustrated as shown in Fig. 5:

In Fig. 5, *A* indicates the curve of impressed electromotive force; *B* the curve of the current which results from this electromotive force. It is a well known fact that the energy upon a circuit at any instant will be represented by the product of the current into the electromotive force. It will be seen that at a number of points within a single complete alternation of the current either the electromotive force or the current passes the neutral line and that one-half of the time the energies will be made up of the products of positive and negative elements. We may call these negative energies and represent them on a second dotted line below by placing them underneath the line. The energies which are made up from elements which are on the same side of the line we will call positive and place them above this line. In this way it will be seen that when the lag or retardation is equal to one-quarter of the total wave length, the negative and positive energies are equal, that is to say, the energy given back to the generator from the transformers or self-induction coils one instant is approximately equal to that given to these coils from the generator the previous instant.

There are elements which can be introduced for the purpose of varying the self-induction of a coil. First, if there is a secondary coil upon the same core the amount of self-induction may be varied by varying the current in the secondary, by varying its resistance; secondly, the resistance or continuance of the magnetic circuit of the core may be so changed as to vary the self induction of the primary. The relation of this feature to the alternating current motor may be traced by taking the example of a series wound motor with a finely divided core in both field and armature. Now, suppose the brushes to be so located upon the commutator that the direction of the lines of force in the core of the armature will be such as to form a continuation of those in the cores of the field magnets, thereby producing a continuous magnetic circuit. The motor then becomes a self-induction coil, and, if properly constructed, it would be difficult to force any considerable amount of current through the same. However, if the brushes be so located as to bring the poles of the armature at an angle to those in the field the magnetic circuit will be partially interrupted, and

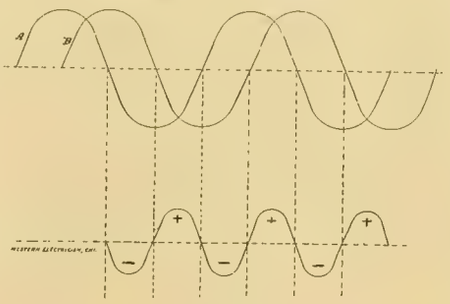


FIG. 5.

the motor then partakes less of the self-induction coil, and actual polarity is developed by its helices in case of both the armature core and the field magnets, with the corresponding torque or tendency to mechanical effort. The maximum effort will be found to rest when the polarities developed in the armature are at right angles with those developed in the fields, or occupy a mid-position between them. Such a motor is illustrated in Fig. 6, in which the outer circular ring forms the magnets which are wound with coils as shown. The next inner circle indicates the armature, and at the center are shown the commutator and brushes. The connections are those of an ordinary series motor. The poles are developed as indicated at *N* and *S* in the field, and when the brushes are set as indicated in

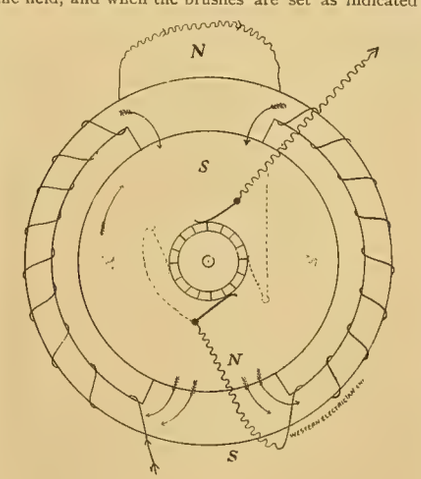


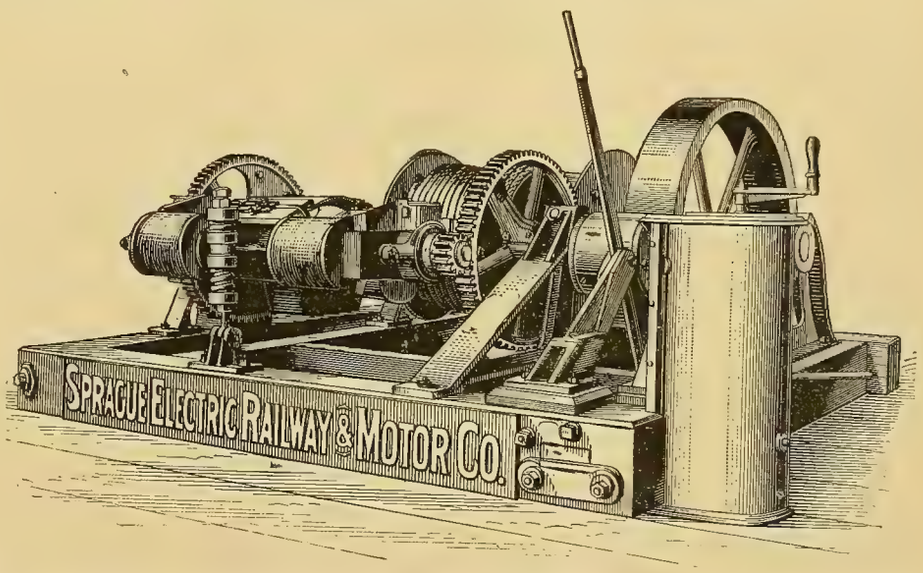
FIG. 6.

the full lines the poles of the armature are *S* opposite *N* and *N* opposite *S*, which would tend to complete the magnetic circuit, and the lines of force will flow as indicated by the small arrows. However, were the brushes to be located to a position indicated by the dotted lines, retaining their respective circuit connections, the continuity of the magnetic circuit would be interrupted, and polarity, and a consequent tendency to rotate, would be developed, inasmuch as the poles of the armature would then be at right angles to the poles of the field, which is the condition of maximum effort in the ordinary motor.

Such a motor can be successfully operated in connection with transformers with this evident advantage, that the amount of energy taken from such transformers can be proportioned to the output by simply changing the self-inductive capacity of the machine in the manner pointed out. It is true that this machine for a given output of energy will have to be made much larger than the direct current motor of the same power, from the fact of the inferior magnetic permeability of the cores of its field, and also from the fact that during a fractional part of the time only in its receiving the maximum energy. The extra size and weight when properly proportioned will not be as much as has been supposed and not in any sense sufficient to bar it from general use, especially will this be true when it is understood that this form of motor is the only one which will not fail utterly under a momentary overload. A condition, the importance of which can not be even overestimated, and again this motor requires no especial device, apparatus or power to start it when the current is turned on. I sincerely hope that a discussion will follow, that the brief outline I have given will lead to an increase in our knowledge of this subject.

Electric Incline Mining Hoist.

The accompanying cut is an illustration of one of the incline mining hoists, operated by a ten horse power motor, of the Sprague Electric Railway and Motor company, now in successful operation in the Veteran tunnel at Aspen, Colorado. This is but a portion of the equipment as other mining hoists and standard machines are being installed for various mining purposes. The motors are operated from a special 500 volt



power plant driven by water power. The dynamos are located about a mile and a half from the end of the tunnel. This is but one of the numerous successful power plants installed by the Sprague company.

Glass Underground Cables.

Glass cables as a solution of the underground telegraph problem is the novel invention of Dr. W. C. Penney of Grant street, says the *Pittsburgh Commercial-Gazette*. The results of twenty years' experiments with electricity are embodied in this device. The new idea underlying it is the perfect insulation of each wire, and the means to be employed in carrying it out is a compact layer of plates of grooved glass. A plate about half an inch in thickness and of any desirable length or breadth is grooved to a depth varying with the size of the wire. In each groove a single wire is placed and cemented in place with pitch, which is as perfect a non-conductor as glass and the only other insulator used. A second layer of glass plates is secured to the first by the same adhesive material and the grooves in it likewise filled, and so on until the conduit contains the desired number of wires. The whole is then boxed in wood and afterwards cemented on all sides, with the exception of the openings left for the purpose of making connections.

At every twenty-five feet, or greater or less distance if desired, the grooves bend at right angles and the wires extend outside their glass inclosure; without being broken they then return, leaving a

curve of wire about an inch and a half in length, which is bent down close to the side of the compact mass. This is true of each and every wire, and at any time the exposed portion can be cut and a battery attached. The convenience of this plan of connecting is greatly increased by the accurate registry of the wires which the discarding of all coils facilitates. The number of ordinary electric wires which can be laid by this method is 100 to the square of four and one-half inches.

Lamp Lighting Schedule — Moonlight System.

JUNE.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H M.	H. M.	H. M.
1	8.00	2.10	6.10
2	8.00	2.40	6.40
3	8.00	3.00	7.00
4	8.00	3.30	7.30
5	8.00	3.30	7.30
6	8.00	3.30	7.30
7	8.00	3 30	7.30
8	8.00	3.30	7.30
9	8.00	3.30	7.30
10	8.00	3.30	7 30
11	8.10	3.30	7 20
12	9.00	3.30	6.30
13	9.40	3.30	5.50
14	10.20	3.30	5.10
15	11.00	3.30	4.30
16	11.30	3.30	4.00
17	12.00	3.30	3 30
18	12.30	3.30	3.00
19	1.10	3.30	2.20
20	1.40	3.30	1.50
21	No	light.	0.00
22	No	light.	0.00
23	No	light.	0.00
24	8.00	9.30	1.30
25	8.00	10.20	2.20
26	8.00	11.00	3.00
27	8.00	11.40	3.40
28	8.00	12 10	4.10
29	8.00	12 40	4.40
30	8.00	1 10	5.10
Total number hours,			140.50

The foregoing schedule is practically good for the United States.
The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise, or one hour before sunrise.
The time for lighting or extinguishing is given for the day on which the night commences.
The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

CORRESPONDENCE.

Indianapolis Items.

INDIANAPOLIS, May 19.—C. Bradford, of the firm of C. and E. W. Bradford, patent lawyers of this city, has bought an interest in the Jenney Electric company. He has been elected one of the directors, also manager of the company, a position which he is in every way capable of filling. He still retains his interest in the patent business.

The committee appointed by the city council to take a trip for purpose of investigating the merits and advantages of the different electric lighting systems, left early this week, and will visit Fort Wayne, Ind., Cleveland, O., and Lynn, Mass., besides several cities where the different systems are in use. From present indications the gas company of this city will strain every nerve to secure the contract for city lighting, and prevent the contract going to an electric lighting company. It is rumored that the gas company intends to reduce the price of gas to $1.00 per thousand feet. Only a month ago they made a reduction from $1.80 to $1.25, at which time the city council offered to renew its contract for light at $1.00 per thousand, but the gas company rejected it, saying $1.25 was the lowest possible price. At that time figures were published from the sworn testimony of an official of the gas company showing it cost 55 cents per thousand to manufacture gas; this included repairs to mains and buildings; so even at a dollar a thousand the gas company would make a handsome profit from its contract with the city.

Ground has been broken in the Circle for the foundation of the soldiers' and sailors' monument, for which among other things specifications call for an electric lighting plant; a number of lamps to be placed on the top, which will be about 275 feet from the ground.

The cyclorama building is now complete and ready for hanging the canvas. The directors contracted this week with the Atlas Engine Works company of this city for the engine and boiler and with the Fort Wayne Jenney Electric company for a dynamo and 30 arc lamps for lighting. Four of the lights are to be displayed from top of the building and the others will be used on the inside.

The grand division of the order of railway telegraphers will hold its annual meeting here in June. Arrangements have been made for a large number of delegates. It is expected the session will last five days. M.

New York Notes.

NEW YORK, May 19.—The annual and general meetings of the American Institute of Electrical Engineers held in this city May 15th and 16th were very fully attended, and the general meeting was especially conspicuous by reason of the presence of an unusually large percentage of prominent electricians. Among others were Prof. Elihu Thomson, of Lynn; Prof. W. A. Anthony, of Manchester, Conn.; Prof. Edw. L. Nichols, of Cornell University; George A. Hamilton, William Maver, Jr., A. S. Brown, Dr. F. Benedict Herzog, Geo. H. Stockbridge, Schuyler S. Wheeler, Dr. Otto A. Moses, Dr. P. H. Vanderweyde, Charles L. Clarke, Nikola Tesla, Walter P. Phillips, Joseph Wetzler, T. C. Martin, W. S. Turner, Clarence E. Stump, Jas. Hamblet, C. S. Bradley, R. W. Pope, Francis R. Upton, Geo. M. Phelps, Jr. and John W. Howell, of New York and vicinity; J. A. Powers, of Troy; Captain O. E. Michaelis, of Augusta, Me. and Edward Weston, of Newark, N. J. the newly elected president of the institute.

A very important illustrated paper will be read before the institute June 12th by Lieut. Frank J. Sprague, devoted to the subject of electric railways, the title being "The solution of the municipal rapid transit problem."

A preliminary meeting was held on May 18th, at 5 Beekman street for the purpose of forming an electrical press association. Messrs. W. A. Kreidler, Clarence E. Stump and Ralph W. Pope were in attendance, and the support of George M. Phelps, jr. and Walter P. Phillips was assured, although neither of those gentlemen could be present at the meeting which was called at short notice in view of the early departure of Mr. Kreidler from the city. Mr. George M. Phelps, jr. was elected president *pro tem.*, and Ralph W. Pope secretary *pro tem.* A subsequent meeting will be held soon to perfect the organization, at which representatives of all the electrical journals are invited to be present.

A meeting of the aldermanic railroad committee was held May 18th at which Aldermen FitzSimons, Conklin, Rinckhoff and Storm, who were the only members present voted to report favorly on the resolution permitting the Fourth avenue railroad to use electricity as a motive power, and will so report to the board next Tuesday. This decision is an important victory for the Julien Electric Traction company. The promoters of the cable system for the Third avenue railroad were not so successful. In this case it was a question of interpretation of the franchise which prohibited the use of steam power. Judge Patterson had decided that this clause did not contemplate the indirect application of steam by means of cable. This decision has been reversed by the Supreme court, which holds that even if steam was used as proposed, no authority existed for excavating the streets to such depth and width as was intended.

The coroner's inquest upon the body of the lineman Thomas Murray was begun yesterday. Very little testimony was elicited from Superintendent McGrath of the Brush Illuminating company, but the proprietors of the store where the accident occurred stated that the wires might have been easily reached from their front windows, and believed that they should have been removed, as the windows were liable to be occupied by their families for the purpose of viewing processions.

Judge Wallace of the United States circuit court in one of more than twenty suits of infringement brought by the Edison Electric Illuminating company against the United States Electric Lighting company for infringement of patents, has sustained the plea of the United States company that it should not be compelled to answer. It is said that the Edison patents have fallen by reason of the expiration of the foreign patents and that the phonograph patents are in a similar condition. P.

From St. Louis, Mo.

ST. LOUIS, MO., May 19.—S. W. Baird, manager of the St. Louis Western Electric Light company, has severed his connection with that company and will devote himself to the selling of electrical apparatus in the southwest. Under his management the St. Louis Western has increased its business in less than a year from 20 arc lights to 160. He secured for the company the contract to light the St. Louis Exposition last year, and at the termination of the contract sold them the plant.

The Laclede Gas company have decided to put in an arc plant of 1,000 lights. The system has not been determined upon as yet. The plant will be located at the company's works at the foot of Florida street.

A. W. Butterworth, representing the Callender company, is in the city looking after the wants of the electrical trade.

G. J. Percival is representing the Woodbury Automatic engine in this market.

F. G. Waterhouse, of the Waterhouse Electric and Manufacturing company, has been in the city for the past few days looking after new business.

The St. Louis Western will increase its plant by the addition of a 90 horse power automatic engine.

St. Louis presents a great field for incandescent lighting, as nearly all of the buildings which have been erected in the past year, both for business and residence purposes, have been wired for incandescent lights. In nearly every case the wiring has been done on the supposition that 100 volt lamps would be used.

The signal boxes used by the Olive street cable are furnished by the National Automatic Fire Alarm company. There will be a box at every corner, and should any accident occur the conductor can stop the cable by opening one of these boxes and pulling down a hook, which notifies the engineer of an accident and at the same time indicates its nature and the place at which it occurred. B.

Duluth's Doings.

DULUTH, MINN., May 19. — Duluth is fast becoming an important center of electrical industry, for the progressive local and contiguous communities are quick to grasp and apply the latest achievements of practical electricity. Rarely a day passes in which cannot be found at some of the hotels of the city representatives of one or another branch of electrical enterprise. A large and increasing amount of bell, gas lighting and annunciator work is being done and the number of electric lighting plants in this section is constantly on the increase.

F. R. Anson, dealer in general electrical supplies and contractor for all kinds of wiring, has under progress the wiring of the new Hartley residence for 150 incandescent lights, a 28-call annunciator, a 14-bell annunciator and 4 straight bells. All wiring is being concealed and put in with okonite insulation. Mr. Anson also has several other jobs under way. Chief-engineer Hathaway, of the fire department, and the superintendent of the fire alarm system, are associated in the electric bell, burglar alarm and annunciator business. These two gentlemen have the prestige and experience to assure success in their undertakings.

The Duluth Electric Light company, Wm. Burgess, electrician and superintendent, is covering the field of station lighting. One hundred Thomson-Houston arc lights are in use and a 650 light alternating current Westinghouse system is being put in. Store wiring for over 100 lights is already done, and the machine will be started shortly. The charge for store wiring is $2.50 per lamp and the schedule of prices for service is: for 9 o'clock lights $1.00 each per month, and 12 o'clock lights $1.50 each per month, the consumer paying for renewals. Mr. Burgess has a commodious and well arranged station, very neat in appearance and economically handled. No better lights can be seen running from any station in the country.

The United States Electric Lighting company have recently completed the installation of an arc light plant on the docks of the Ohio Coal company. F. E. Scovill, of St. Paul, had charge of the work, and the results are so satisfactory that other companies here and at West Superior are contemplating fitting out their docks with arc light apparatus.

The West Superior Light company now have their system complete for lighting the streets of the town, and will start up as soon as lamps are received. No house wiring has yet been done, as all attention has been devoted to the street lighting system, which has proven an undertaking of considerable magnitude. The commercial circuit will now be pushed forward and the business community furnished light at an early date.

The incandescent plant in the great Northern elevator consisting of 200 32-candle-power lamps and dynamo of the United States Electric Lighting company's system, is standing the test of continuous usage admirably. The elevator is excellently illuminated throughout, and the lamps are averaging way up in the thousands of hours lifetime.

The new 300 light plant recently put into the Duluth Elevator company's three elevators by the United States Electric Lighting company, is a model for elevator lighting; many of the novel features were designed by Geo. D. Moulton, superintendent for the elevator company, and are worthy of special commendation. Mr. Moulton is quite an expert in electrical matters and is prolific in expedients for calling the subtle force to his aid in facilitating the various operations around an elevator. He has had the lighting system divided into circuits, technically known as the work and watchman's circuits, and all controlled from a complete system of switches located at the dynamo room. When no operations are going on in the elevators, only the watchman's circuit is on, which furnishes light for the patrol who make the round of the building during the entire

night. In case of fire or when light is wanted for working operations, the full number of lights can be flashed on instantly. Long flexible cables are provided for lowering lights into the immense bins seventy feet in depth, and for carrying light into cars while unloading is taking place. Mr. Moulton has had placed in the elevators the New Haven Clock company's system of watchman's signal and fire alarm service, also an automatic system of sprinklers. Fire is the great bug-bear of elevators; but with the automatic sprinklers, watch signal and fire alarm system, and incandescent lights, Mr Moulton has reduced to a minium the danger from that element in the Duluth Elevator company's elevators. S.

St. Paul News.

ST. PAUL, Minn., May 19.—The present condition of the Mississippi river at St. Paul, in its volume and expanse of surface, its swiftness of current and impatience of restraint, rivals the normal condition of the mighty river when a thousand miles nearer the sea than here. Thousands of acres of lowlands around St. Paul are inundated. Hundreds of cabins and shanties of the poorer class are only visible by their roofs, and real estate dealers are platting and selling lots now under a murky sea of from two to fifteen feet of exceedingly chilly water. Your correspondent saw surveyors waist deep in water, staking off lots, apparently considering the difficulties under which they worked as only a good joke. Can any of St. Paul's rival cities show a more enterprising spirit than this?

The first public trial of the Enos system of single rail elevated electric railway was given in South Park recently. There was a noticeable absence of the difficulties both mechanical and electrical usually attendant upon first trials of new machinery. The portion of track now completed and upon which the test was made has an average of a 6½ per cent. grade and has many single and compound curves of very short radius. The car, fully loaded with spectators, made many trips up the line, about ¼ mile and back, and was under perfect control of a single operator, being instantly responsive to any demand made upon it. A speed of about six miles per hour was maintained up the steep grade and around the serpentine curves of the route. The system was pronounced a perfect success by the large crowd of spectators, and the smiling countenances of the stockholders of the company attested their eminent satisfaction.

The lobby of the Merchants hotel was quickened into good humor and hilarity on the advent into its precincts of the jovial senator Henry Keller of Sauk Center, Minn. The senator's droll expressions and overflowing wit and good nature made him the center of an admiring crowd of strangers as well as friends. His sunny disposition is contagious and his presence will cure the worst case of melancholy. The senator was down to purchase ten car loads of iron for the Keller Manufacturing company of Sauk Center and also to make arrangements for an increase of his electric light plant. Mr. Keller is running a United States Electric Lighting company's 225 incandescent light plant for commercial lighting. The city council of Sauk Center have just awarded Mr. Keller a contract for street lighting, and this together with the increased demand for commercial lighting induced him to double the capacity of his plant. Mr. Keller swears by the United States company's system and could not be induced under any circumstances to experiment with any other. He states that he made the subject of electric lighting a special study for a year previous to making an investment and finally decided that the United States company's long distance system was the most applicable for his use.

J. L. Barney, electrician and superintendent of the Chippewa Falls Electric company paid a short visit to St. Paul recently. Mr. Barney operates the United States Electric lighting company's long distance system of incandescent light for commercial lighting in Chippewa Falls. His station has a dynamo capacity of 875 lights and the demand for lights is so good that the company is contemplating increasing its capacity with a 500 light alternating current system, and having it ready for fall business. W.

From Topeka.

TOPEKA, May 21.—B. Rorison, of the Jenney Electric Light company says the arrangements for operating the plant in this city are progressing satisfactorily and that all arrangements will be completed before the date named in the contract, June 20th. He was informed by City Attorney Bird that a petition had been presented to the city council asking for an additional number of lights in the southwest portion of the city. Mr. Rorison says arrangements could easily be made to supply the extra lights. The addition of another dynamo would furnish sufficient current. The total additional cost he said would be about $10,000. The only difficulty that presented itself was one of finance. The Jenney company, he said, would not care to make the outlay on the same terms entered into with the city for the plant. He would be pleased to agree to extend the plant and accommodate the people of this city in any way that he could in justice to his company, but for the company to invest another $10,000 in the plant in addition to the amount already invested, which is non-interest bearing, would not be good business. Mr. Rorison suggested that a plan might be arranged for the moneyed men to advance the money, guaranteeing 8 per cent. interest for the twelve or eighteen months before the city could pay.

The Interstate Telephone Company, of Kirwin, has been incorporated with capital stock of $10,000. The directors are C. W. Hull, M. H. Johnson, F. R. Kimberly, H. A. Royce, J. L. Troup.

A new electric plant is now an assured institution for Fort Scott. The parties interested have perfected all their arrangements, secured the needed subscriptions to the capital stock, and are about to begin operations upon the establishment of the plant. This system will include both the incandescent and arc lights. The latest and best machinery and appliances will be used, and a considerable amount of money will be expended in establishing the works and laying the lines. McD.

THE ELECTRIC LIGHT.

The Schuyler Electric Light company will erect a new plant at Knoxville, Tenn.

The Thomson-Houston Electric Light company needs additional land at West Lynn for an extension to its present plant.

The Hastings Electric Light and Power company, of Hastings, Minn., has been incorporated with a capital stock of $15,000.

The Western Electric company of Chicago, has received an order for a twenty-light arc plant for the Daniel Shaw Lumber company, EauClaire, Wis.

The Edison Electric Light company has been granted permission to lay conduits in portions of Market, Walnut, Second, Ninth and Sixteenth streets, Philadelphia.

The Thomson-Houston station at Bloomington, Ill., has recently been in charge of J. C. Miller, and the service is giving entire satisfaction. There is talk of the sale of the plant to the city.

The Jersey City Electric Light company is now running fifteen dynamos with a capacity of 260 lights. They are about putting in batteries manufactured by the accumulator company, New York, and will introduce the incandescent light.

The Fort Plain (N. Y.) Gas and Electric Light, Heat and Power company, with a capital of $31,000, has been incorporated by E. W. Wood, William Clark, A. Dunn and others. It proposes to furnish gas and electricity in the villages of Fort Plain, Nelliston, Palatine, Bridge and Canajoharie.

The Chicago city hall is frequently full of gas, and the officials complain that the nauseating odor has made several of them ill. In order to find the leaks the conduit of the electric light company was broken into, but nothing found. It is believed that the gas which enters the city hall comes from an orifice close by the building.

In the United States circuit court in New York Judge Wallace rendered an important decision last week in favor of the defendants in twenty-six suits for infringement of patents brought by the Edison Electric company against the United States Electric Lighting company. The suits were instituted about three years ago and related to certain alleged infringements on patents for incandescent lamps. The defendants' counsel took the position that the Edison patents could not be infringed for the reason that they had expired. Judge Wallace allowed this plea to the bills of complainant.

THE ELECTRIC MOTOR.

The railroad committee of the New York common council has reported favorably the Fourth avenue railroad company's application to use electric motors.

The Sprague company have just received an order for a large number of motors to be used in the new marble building of A. J. Drexel, Philadelphia. The average power of the motors is about 7½ horse power.

The Sprague Electric Railway and Motor company are just completing an installation of electric motors at the Ophir farm, White Plains, N. J., the country residence of Whitelaw Reid. The motors are to be used for pumping water, stable work, and other purposes.

In speaking of the advantages of the electric street railroad the Chicago *Daily News* says "the question of cost remains to be settled, but enough has been already determined to warrant the assertion that it will certainly not be greater than that for horses. If the Chicago city council does not belong entirely to Baron Yerkes it will take some cognizance of these facts before allowing him to inflict his cable nuisance on another division of the city."

A week ago last Sunday being a pleasant day, it was decided to put on the Richmond electric road the ten open cars. This meant the immediate employment of forty new men, conductors and drivers, ten of each for day and night service respectively, who knew comparatively nothing about electric railroads, and especially of this most difficult road to operate on account of the heavy grades and sharp curves. That everything ran smoothly without hitch or fault, nearly thirteen thousand passengers being carried, shows the perfection of the Sprague system.

The Supreme court of Iowa has rendered a decision of general interest in the famous street car case of Des Moines, Ia., granting to the Broad Gauge company the right to use any kind of motive power except horse power. Twenty-two years ago the city council granted to the Narrow Gauge company the exclusive charter to operate a street railroad for thirty years. After having a monopoly of the street car business for twenty years a rival company was organized and has been in litigation with the old one ever since. The Supreme court held that the old charter granted exclusive rights for horse power on all streets occupied by the old company. This knocked out the new company, which had already expended $150,000 in a plant, unless it could operate some other motive power. The city council granted a charter for an electric railway, and the Supreme court was asked to decide on the new phase of the question.

The practicability of employing electricity as a motive power for stationary mechanical plants is no longer open to question as to either its economy or its effectiveness. Albert Gray, who has been, during fifteen years past, supplying steam power from a central plant at 57 Park place, has, within seven weeks past, established at the same place an electrical plant and demonstrated that it can successfully compete with either the most economically conducted private power plants the service of the Steam Heating and Power company, or any system of shaft and pulley power transmission. He employs three engines of an aggregate 450 horse power, and three Daft dynamos which are capable of transmitting to consumers an energy equivalent to 400 horse power. The territory in which he possesses the exclusive right to employ the Daft system for generating electric power is bounded by Broadway, Canal street, the North River, and the Battery. In addition to his present plant he is now erecting another on Duane street, below West Broadway, that will have a capacity of 1,500 horse power. Thus far, he supplies 280 horse power to about eighty customers, but would already be running to the full extent of his capacity if he were able to obtain sufficient motors to meet the demand for them.—*New York Sun.*

THE TELEPHONE.

The exchange of the Cushman Telephone company at Logansport, Ind., will probably be opened for business by June 15th.

The Cushman Telephone company will probably begin the work of soliciting subscribers for the Chicago exchange next week.

The office of the secretary of the National Telephone Exchange association is now located in room 512, 18 Cortland street, New York City, in the Metropolitan Telephone company's building. The treasurer's office remains in room 501 of the same building.

M. P. Germain has carried out some experiments upon the French railways with a view to determining the possibility of communicating with a train in motion by means of a telephone, using the two rails as conductors. His experiments seem to have met with a considerable degree of success.

The Bell Telephone company, of Buffalo, N. Y., has settled with the heirs of James F. Norton, the colored man who was killed some ten weeks ago while attempting to rescue a horse from a telephone wire which had fallen across the electric light wire and become charged with electricity. The amount paid was $3,500.

A dispatch from Boston says: The American Bell Telephone company has issued a circular offering stockholders the right to subscribe at par for 2,000,000 seven per cent. ten year bonds, issued for the construction of the long distance telephone system. The company will have the right to redeem the loan Aug. 1, 1890, or any interest day thereafter at 1 10 and interest. The transfer books close from June 1 to June 10, inclusive. Each holder of fifty shares is entitled to subscribe to one $1,000 bond.

At Denver, Col., William Gamewell appeared in the District court of the first division in a suit against the Colorado Telephone company, for the recovery of damages for injuries sustained by a fall from a telephone pole. When the plaintiff removed the wire from the top of the pole the pole fell, throwing him to the ground and rocks below, causing very serious and severe injuries to his back to such an extent that he is permanently disabled. When the plaintiff rested his case Attorney Vail, on behalf of the defendant company, moved the court for non-suit, principally upon the ground that the plaintiff had not shown his lack of knowledge of the condition of the pole, and that he had not been specially directed to climb and work upon this pole; in other words, that the plaintiff had not fully proven the allegations of his complaint. General Brown contested the motion, but the court sustained the motion and the case was dismissed upon non-suit.

An interesting case to telephone and telegraph companies, and one involving some novel and important points, was recently decided in New Jersey. A man named Dexheimer, having received permission from the city authorities of Orange, N. J., to move his house through the streets, notified the New York and New Jersey Telephone company, to temporarily remove some of its wires, so that his house might pass. The company offered to do this, if Dexheimer would pay the actual cost of the labor, but not otherwise. He refused to pay anything, and cut the wires himself. The telephone company thereupon brought suit for damages. The case was tried in the Circuit court, Essex county, New Jersey. Judge Depue, of the Supreme court, who presided at the trial, held, that a telegraph company was entitled to recover damages caused by the cutting of its wires by a contractor in order to make way for a house which he was moving along the highway, across the line of the telegraph company. He also held that permission from the local authorities was no defence to such an action, the moving of a house, or rather such structure, on the highway, not being one of the rights of the general public in the highway; and also that such house moving did not come within the definition of travel in the

statutes requiring that the lines of telegraph companies should be so constructed as not to interfere with public travel. By the judge's charge, it is settled that in New Jersey, a telephone company is not obliged to remove its wires at the behest of house movers, if the wires are erected according to law. In this particular case, although the evidence was conflicting, the jury decided that the wires which were cut, were located less than twenty feet—the legal height—above the ground, and therefore found a verdict against the telephone company. The points of law, in the charge of Judge Depue, are however, just as valuable for a precedent, and it may be said that the New York and New Jersey Telephone company sustained a defeat which was really a victory.

THE TELEGRAPH.

Old Man—"My boy, I have made a success of my life, and I owe it to the principle taught me when I first went out into the world to earn my own living." Young man—"What was the principle?"—"Be slow and sure."—"What did you do when you first went out to work.?"—"I was a telegraph messenger."—*St. Paul Globe.*

According to Prof. Gould's investigations it appears that aerial telegraph wires on poles transmit electricity at the rate of from 14,000 to 16,000 miles per second, and that the velocity of the transmission increases with the distance between the wires and the earth, or in other words, with the height of suspension; and that subterranean wires, like submarine cables, transmit with reduced rapidity. Again, while wires sus, ended at a feeble height are known to transmit signals at a velocity of some 12,000 miles per second, those that are suspended higher give a velocity of from 16,000 to 24,000 miles.

Personal Paragraphs.

Wm. J. Buckley, manager of the Chicago office of the Fort Wayne Jenney company, is having his new quarters at 225 Dearborn street, first floor, fitted up in the most elegant style.

Forée Bain, of 76 Market street, Chicago, is not only a genius in the electrical line, but in almost any other to which he devotes his attention. One of his latest exploits is an exceedingly simple gas generator, by the use of which gas can be easily and safely generated in a house at a cost of about 35 cents a thousand.

Business Notes.

The Sprague Electric Railway and Motor company have removed to their new offices, 16 and 18 Broad street, N. Y., where they will be pleased to receive their customers.

The Eddy Electric Mfg. Co. has removed its office and factory from Hartford, Conn., to Windsor, Conn., where all correspondence should be addressed. The facilities of the company have been enlarged to meet the constantly increasing demands of the trade.

The Electrical Supply company, of 171 Randolph street, Chicago, has issued a new catalogue, containing a list of electric light tools kept in stock by the company. It is a handsome piece of work, and is complete in every detail. It would be difficult to name any article needed by an electric light company which is not to be found in the catalogue.

The Van Depoele Electric Manufacturing company, of Chicago, have recently issued a catalogue of letters, reproduced from the originals by a system of photo-engraving, all bearing upon the merits of the Van Depoele light. All the letters are of recent date, and the writers speak from an experience with the light varying from two to seven years. In each case unqualified satisfaction is expressed with the light and its operation.

Gilbert M. Smith has been appointed manager of the Chicago office, at 64 Washington street, of the Ansonia Brass and Copper company, of Ansonia, Conn., and has already taken up his residence in this city. At the Chicago office a large stock of insulated wire for ele trical purposes is carried. By the way, the 1888 electric wire list of this company is a compendium of useful information in a very handy form.

The following complimentary letter was received last week from the syndicate which put in the Richmond Union Passenger railway. The Sprague company had no interest in this road, nor has the syndicate any interest in the Sprague company. This road is not only an electrical but a financial success, having on certain days carried nearly thirteen thousand passengers. The letter is addressed to E. H. Johnson, president of the Sprague Electric Railway and Motor company, and is signed by Thornton N. Motley, Henry Steers, Maurice B. Flynn, committee on construction: "New York, May 15, 1888. We take pleasure in notifying you of our acceptance of the electrical equipment of the Richmond Union Passenger railway. The road which you have equipped under most trying conditions has been one of the most difficult, if not the most difficult, which could be met with in street railway work. The excessive and continuous grades, the numerous and sharp curves, the gradients in these curves, the weight of the cars and the heavy loads which they have been required to carry, together with the extent of the system and the number of cars in operation, constitute the enterprise the largest and most difficult of its character yet inaugurated in any part of the world. We must confess that we have sometimes shared the doubts that others have been so free to express as to the possibility of the successful completion of this work; and hence it is with the greater pleasure that we acknowledge the successful fulfillment of all the terms and conditions of the contract, and compliment you upon having achieved so signal a success. The immediate financial success of the road has been unquestionably due in a large measure to the economy developed in the operation of your system as compared with any other method of street car propulsion. We shall be pleased to meet your treasurer to day, when we will make a full settlement as agreed. We are already contemplating an increase of equipment, and hope before the close of this year to have at least seventy of your cars in operation."

Electrical Patents.

Issued May 15, 1888.

382,714. Switch for Electric Motors. Richard H. Mather, Windsor, Conn.

382,715. Switching Device for Electric Motors. Richard H. Mather, Windsor, Conn.

382,726. Locking Device for Cable Splices. William R. Patterson, Chicago, Ill.

The invention consists in a locking device which encircles the joint of the cap and a pin connected therewith to hold in place the screw-plug, which closes the opening to the test wires.

382,734. Coin-Operated Electrical Apparatus. Norman W. Russ, London, England.

382,738. Galvanic Battery. George H. Sloane, Boston, Mass.

382,741. Railway Signal. Charles D. Tisdale, Boston, Mass.

382,756. Fare Box. Walter A. Crowdus, Dallas, Tex.

382,766. Electro-Magnetic Car Brake. Albert P. Massey, Watertown, N. Y.

382,767. Manufacture of Telegraph Cables. William R. Patterson, Chicago, Ill.

"Claim. 1. In an electric cable, the combination, with the core of insulated conductors, of a waterproof pipe inclosing the same, and a serving between the interior of the pipe and the conductors, said serving being in bunches, the bunches being compressed by the pipe, whereby air spaces are formed and the compression of the covering of the conductors at said air spaces prevented."

382,768. Method of Manufacturing Electric Cables William R Patterson, Chicago, Ill.

The invention relates to the method of and apparatus for manufacturing electric cables, whereby a core of loosely twisted conductors is covered by a lead pipe. The core is unserved and the wire is so disposed as to substantially fill the pipe. As the core is only loosely twisted, the fibrous insulating covering of the conductors will not be compressed, and the wires being arranged so as to occupy substantially the whole space within the pipe and being substantially at uniform distances apart, the electrostatic capacity of a cable of a given size will be the lowest possible. The cable also will be quite flexible, and there will be little or no danger of breaking or injuring the pipe or conductors by bending.

382,778. Underground Conduit for Electric Wires. Walter F. Smith, Philadelphia, Pa.

382,781. Insulated Wire. Joseph D. Thomas, New York, N. Y.

We give the last claim: "5. The method of covering wire with a triple coating herein described, consisting in first applying a soft rubber coat to the naked wire, and thence winding over said coat two successive spiral windings of tape, each wound in opposite directions."

382,788. Automatic Fire Alarm. John Young, Chicago, Ill.

The object of the invention is to enable the watchman at a fire patrol station or engine house to distinguish true alarms from those sent in accidentally.

382,811. Electro-Medical Apparatus. Peter Hor t, Sioux City, Iowa.

382 829. Telegraph Cable. William R. Patterson, Chicago, Ill.

The invention is designed to render cables more durable, of higher insulation and of better appearance than heretofore; and it consists in a layer of dry paper tape either outside or inside of lead tape, or preferably inside and outside of lead tape, whereby the shellac or paint from the lead tape is absorbed, and cutting or puncturing of the lead tape is prevented, while the cable rendered smooth and even.

Claim: '3. The combination in a telegraph cable of a winding of lead tape with shellacked and over lapping edges, a bed or winding of paper tape under the lead tape for absorbing the excess of shellac, the core of conductors, and an outer serving."

382,845. Commutator for Dynamo Electric Machines. Nikola Tesla, New York, N. Y.

382,8 ,6. Manufacture of Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.

The invention relates to the manufacture of incandescent electric lamps; and the object of the invention is to provide convenient and efficient means for expelling the occluded gases from the carbon points formed by the union of the filament with the leading-in wires. This is accomplished by heating the leading-in wires and the points independently of the filaments themselves both during the process of evacuation and after the air has been exhausted, by means of electric currents caused to pass from an independent con. uctor to the respective joints and through the filament.

382,856. Repeating Induction Coil. John A. Barrett, Brooklyn, N. Y.

382,876. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

Claim 1. "An electric car or motor provided with an armature adapted to be attracted by the poles of the motor, and friction brake mechanism actuated by said armature."

382,877. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

382,914. Electric Indicator. John Tregoning, Hartford, Conn.

382,941. Electrical Agricultural System. Edward M. Bentley, New York, N. Y.

The invention relates to a system of supplying electricity from a central station to a movable electric motor adapted to reach any part of a field or district, and it is especially applicable to agricultural purposes where a harvesting machine or other agricultural implement is to be propelled by a motor over a certain area of ground. It is evident that such a machine must have both a longitudinal and a transverse movement and still maintain its connection with the source of current supply. The invention therefore consists in suspending a line of conductors along one side of the field or district and providing a secondary conductor having a length equal to the transverse dimension of the field, which has a traveling contact on the main line, and with which the moving motor is in constant connection.

The last claim reads: "10 The combination, with a moving vehicle, of an electric translating device thereon, a stationary source of current, an intermediate conductor, and a winding drum for said conductor movable about a vertical axis."

382,968. Storage Battery. Charles D. P. Gibson, New York, N. Y.

"Claim 4. The method described of filling cavities in the plates of a storage battery by immersing in a suitable liquid and electrically connecting and sending a current through the plates under such conditions as to fill the cavities with peroxide by disintegration or deposition, or both, and exposure of plates to crystallize and absorb oxygen."

382 976. Electric Tele-Thermoscope. Harry W. Hardinge, Leadville, Col.

382,990. Electrically Propelled Vehicle. Walter H. Knight, New York, N. Y.

The invention relates to electrically propelled vehicles, and it consists in an electrical or circuit controlling regulator for the propelling motor, which is controlled by the same manual devices at each end of the vehicle by which the brake of the vehicle is actuated.

Last claim: "6. The combination, in an electrically propelled vehicle, of a resistance, a brake, and a common actuating device therefor extending to opposite ends of said vehicle."

382,997. Directory Indicator for Buildings, etc. Thomas J. McTighe, New York, N. Y.

383,013. Telephone Exchange System. Charles E. Scribner, Chicago, Ill.

The invention is designed for use in connection with a system of telephone exchange in which complete metallic telephone circuits are employed. The invention consists in new switching apparatus and circuits for the subscriber's outfit, by means of which a subscriber who desires to talk to the central office may ground his metallic circuit through his telephone and connect the two with the listening operator as a single ground circuit.

"Claim 1. The combination of a metallic circuit with a branch circuit containing the operator's telephone and a switch included in the metallic circuit, whereby said metallic circuit may be connected to and disconnected from said branch circuit.

"3. The united metallic circuits of two subscribers, in combination with a branch circuit to ground, including an annunciator and battery and switches, whereby either subscriber may ground the metallic circuit, and thereby close the battery and drop the annunciator."

383,014. Switch-Board. Charles E. Scribner, Chicago, Ill.

The object of the invention is to so arrange the cords that the plugs may be carried up out of the way when not in use, and yet remain within easy reach of the switchman.

383,015. Clearing-out Annunciator. Charles E. Scribner, Chicago, Ill.

The invention provides for a clearing-out signal at the central office which is not actuated where one subscriber calls another, but which may be actuated at the will of the subscriber.

"Claim 5. The combination, with an electro magnet normally shunted out of circuit by the polarized armature of the electro-magnet of an annunciator, of the neutral armature of said electric annunciator extended to form a double detent, the iron shutter supported thereby, said shutter being presented to the poles of the normally shunted electro-magnet, whereby the shutter is retained in position or allowed to fall, according as current of one polarity or current in reversals is sent through the annunciator."

383,016. Automatic Shunt for Magneto Generators. Charles E. Scribner, Chicago, Ill.

The invention relates to dynamo or magneto electric machines, and is designed to automatically open the shunt circuit around the machine when the armature is in motion, so that the current generated may be sent to line.

"Claim 1. The combination, with a dynamo or magneto electric machine, of a shunt circuit around the machine, an extra coil upon the armature, an electro-magnet included in the circuit of said extra coil, and the armature lever of said electro-magnet included in the shunt circuit, whereby the shunt circuit is held open and current sent to line when the machine is in operation."

383,017. Test Circuit for Telephone Call Boxes. Charles E. Scribner, Chicago, Ill.

The invention relates to testing magneto bells, or telephone call boxes, and it consists in certain modifications of the circuits and switching devices, whereby the generator and call bell of the box may be used for making the tests required.

383,018. Key Board Apparatus for Telephone Exchanges. Charles E. Scribner, Chicago, Ill.

The invention consists in providing a switch device, in connection with the listening key or loop switch, by means of which the strand of the cord connecting with the sleeves will be closed to ground when the operator's telephone is looped into circuit of the cords.

383,046. Incandescent Lamp Attachment. Harry M. Doubleday, Columbus, Ohio.

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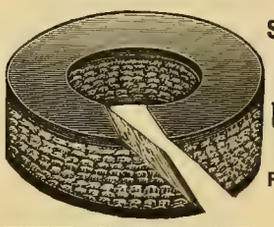

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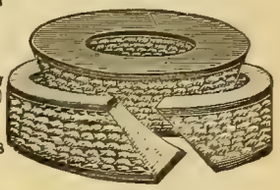

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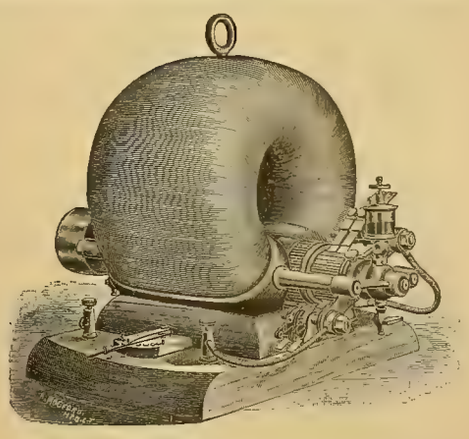

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[Extract from Mayor Clark's speech.]

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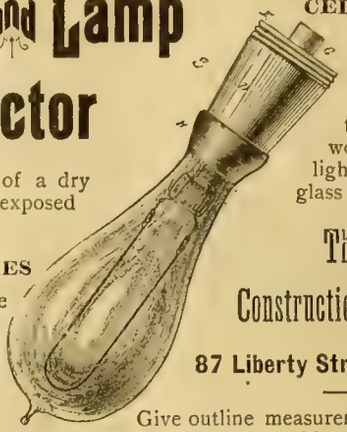

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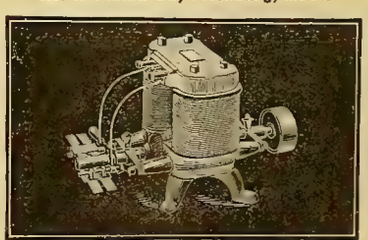

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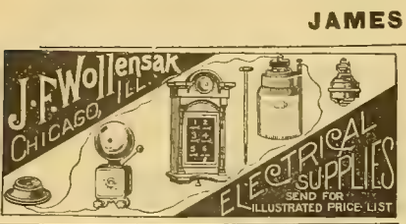

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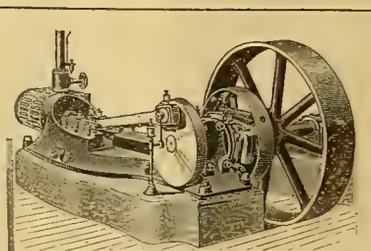

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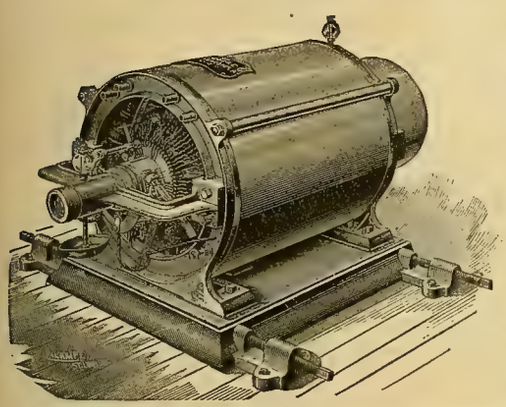

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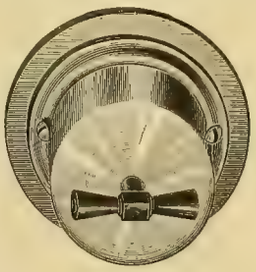

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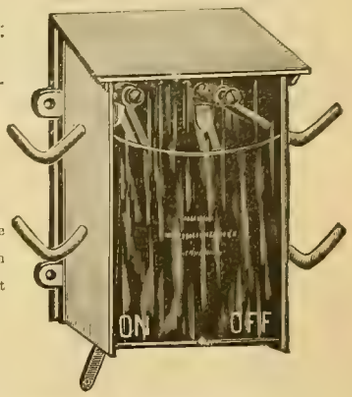

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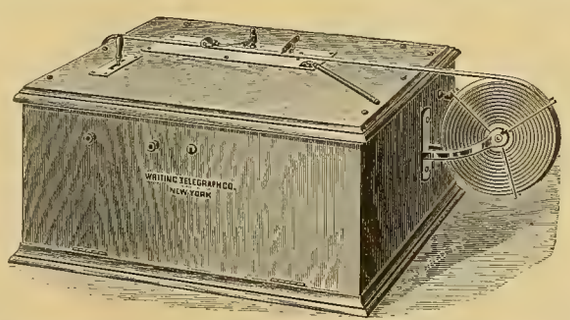

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PRESS NOTICES:

Electrical World, April 7, 1888.

Although most electric lighting companies publish short rules for the guidance of those in charge of their apparatus, still the kinship of all dynamo machinery is so close that a series of rules which shall be general as to their installation and care are evidently of considerable value to those who may have to operate the different types of machinery by various makers. It is with the object of presenting such general rules that Mr. Badt has prepared the little work before us, and it must be acknowledged to be a very simple and lucid explanation of the management and operation of electric light plants. The rules are, of course, designed to be eminently "practical," and will, therefore, be looked upon with special favor by those in charge of such machinery. The book includes an elementary discussion of the principles involved in various types of machines, the manner of starting up plants, the keeping of the machinery in good order, the repairs which may have to be made to various parts, and the testing of the machine to determine faults. A series of chapters also treat of the manner of handling lamps, running lines, and installing the various multiple series systems and plain incandescent systems, and the use of indicators in station work. The accumulator is also discussed briefly, and the book closes with the rules of various underwriters' associations. The text is elucidated with over 70 clear illustrations, and this, together with the convenient size in which the book is published, cannot fail to make it a valuable companion to those for whom it is intended.

Modern Light and Heat, March 29, 1888.

Among the hand books which are of use to non-professional readers who wish to gain some slight knowledge of electric machinery, may be mentioned the Dynamo Tenders' Hand Book, by F. B. Badt, a copy of which has been received at this office. This little book, which is very primitive in its character and presupposes no electrical information on the part of the reader, would be of use to any intelligent person placed in charge of a dynamo machine; though it would not replace the more complete hand books now on the market. This is not intended for a criticism for it is the evident purpose of the book, as may be seen from the author's words in the preface which we here quote "the author has striven to lay down * * * general rules for the care and operation of electric light installations and discarding entirely the use of technical phraseology and scientific terms and formula, has endeavored to confine his use of words to those very plain, simple and elementary in character." The book is well printed on good paper and neatly bound in black cloth.

Chicago Daily News, April 27, 1888.

Dynamo Tenders' Hand Book is, as its name indicates, a work containing the first principles underlying the philosophy of electricity as applied for illuminating purposes, and practical instructions as to the care and operation of dynamos and other electrical appliances. Though a small volume the book is comprehensive, is copiously illustrated and, coming as it does from a practical engineer—Lieut. F. B. Badt of the Royal Prussian artillery—should be reliable.

Electrical Review, April 7, 1888.

Of all the volumes which have hitherto been published relating to dynamo electric machines and their operation, few of them have gone into the practical details of the care of the machines and general equipment of the station in such manner as would enable unskilled attendants to comprehend and carry out. This little book is unique in its simplicity of language, its avoidance of the hard words and the technical expressions and definitions of the ordinary text book. It is exactly what its name indicates, and to dynamo tenders, engineers. linemen and others, who are daily looking after plants and parts of plants, this little book is full of information and points, which it is needless to say the author is most competent, from his extended experience, to give. The whole book is full of illustrations, and is written in such a manner "that he who runs may read." The portions devoted to "diseases of dynamos" and the remedies therefor, the chapters on arc lamps, instruments, and various ready methods of testing for faults anywhere in the system are specially worthy of attention. In fact the book contains information for everyone interested in electric lighting, and should be in the hands of all station attendants and linemen.

American Correspondent London Electrician, April 20, 1888.

In regard to books, I may mention the appearance of a very handy little book giving instructions to dynamo tenders, in the construction, maintenance and operation of electric light and power plants. It is published by the *Western Electrician* Company, of Chicago. The author is Mr. F. B. Badt, who was at one time, I believe, an officer in the Prussian army, and is now connected with electric lighting in Chicago.

Light, Heat and Power, April 16, 1888.

Mr. Badt has embodied general rules for the guidance of those in charge of electric lighting apparatus, in his little volume, and has included many points and matters of general interest. He has discarded technical phraseology and the intricate scientific formulæ, as far as possible, and has brought his directions within the grasp of the many who need such instruction, and who have not had the desirable technical pre-education.

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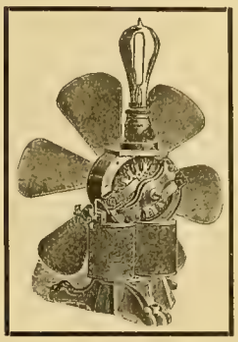

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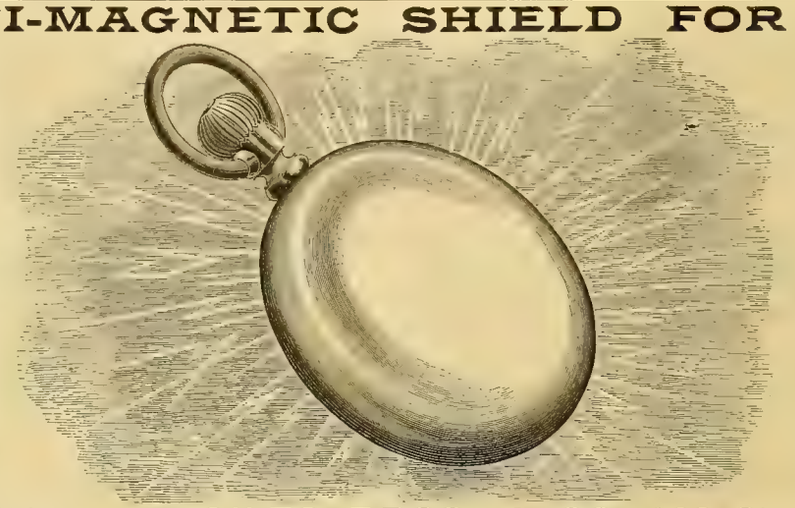

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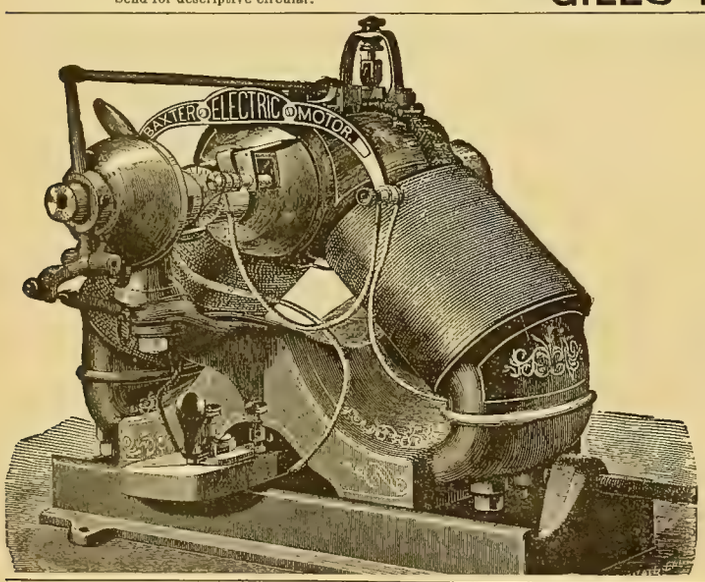

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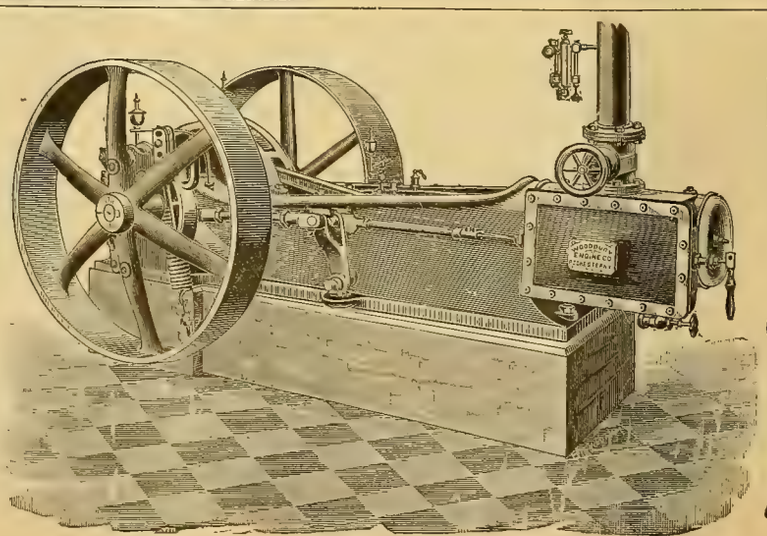

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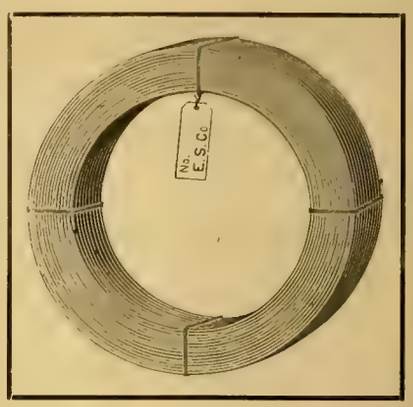

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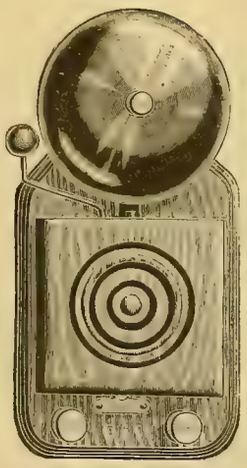

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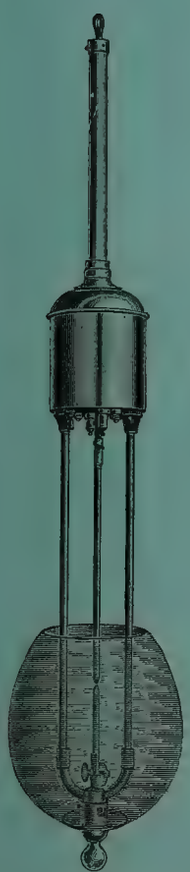

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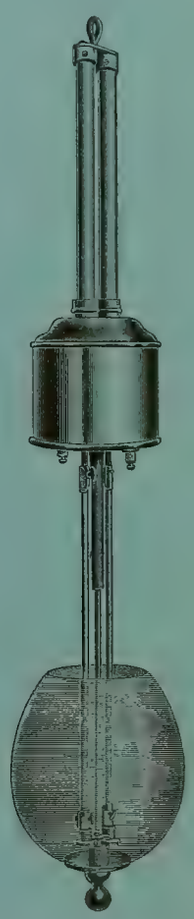

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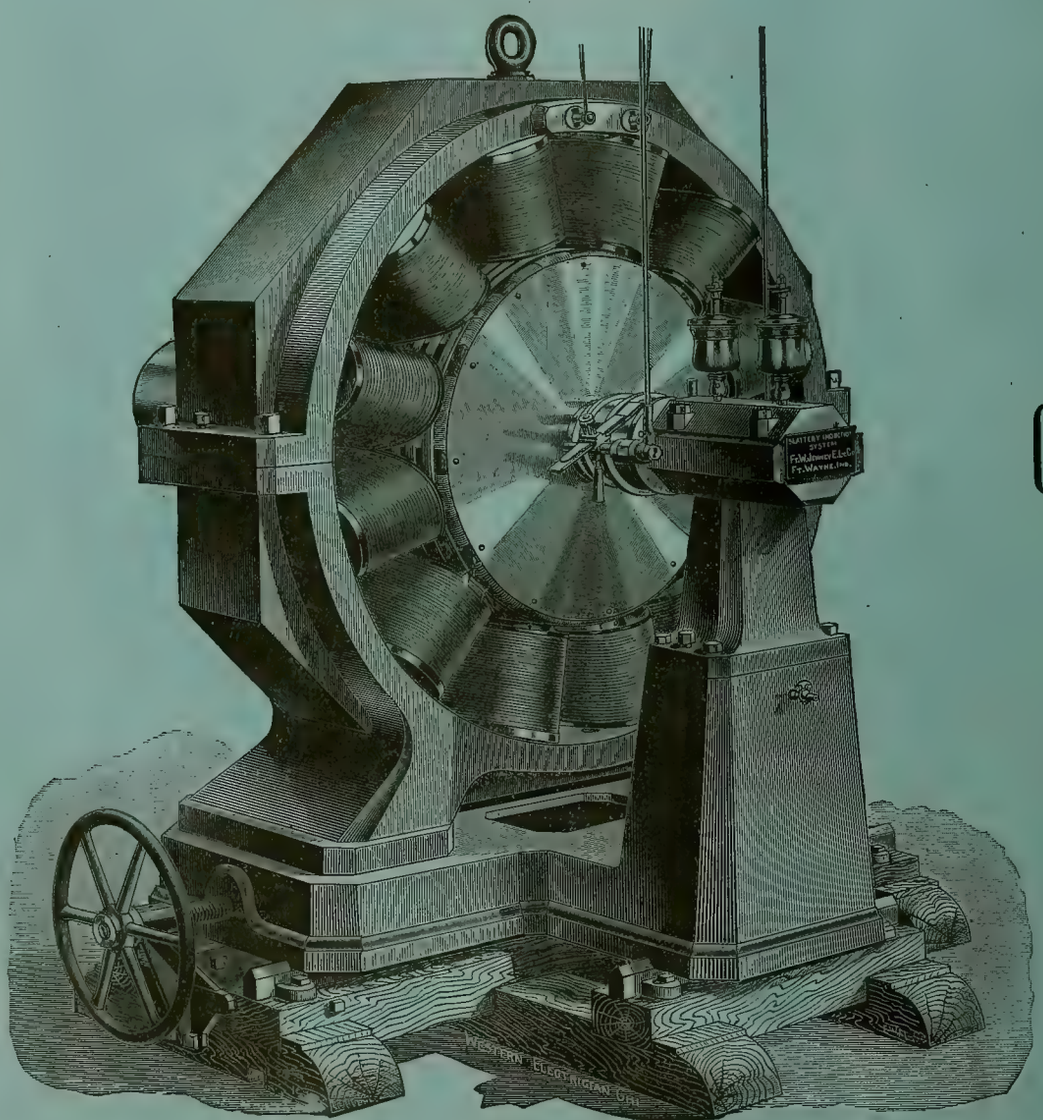

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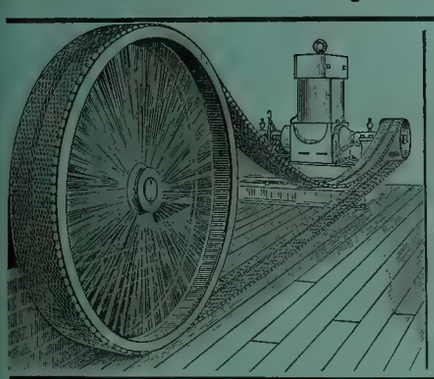

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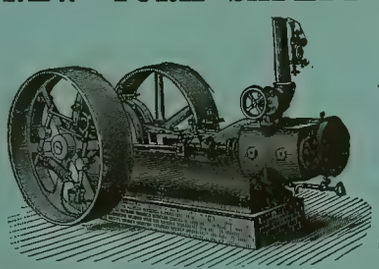

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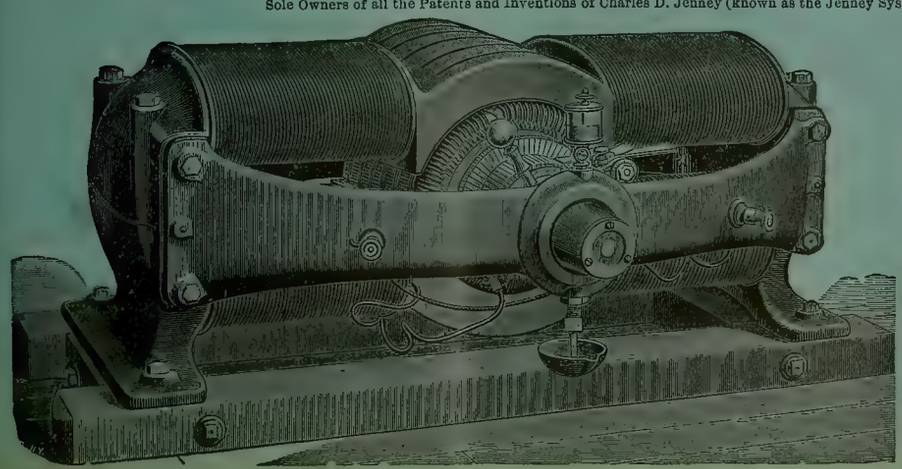

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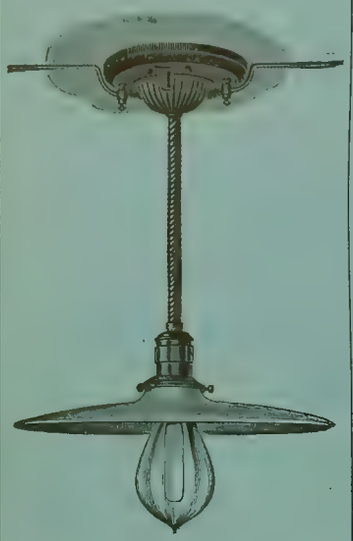

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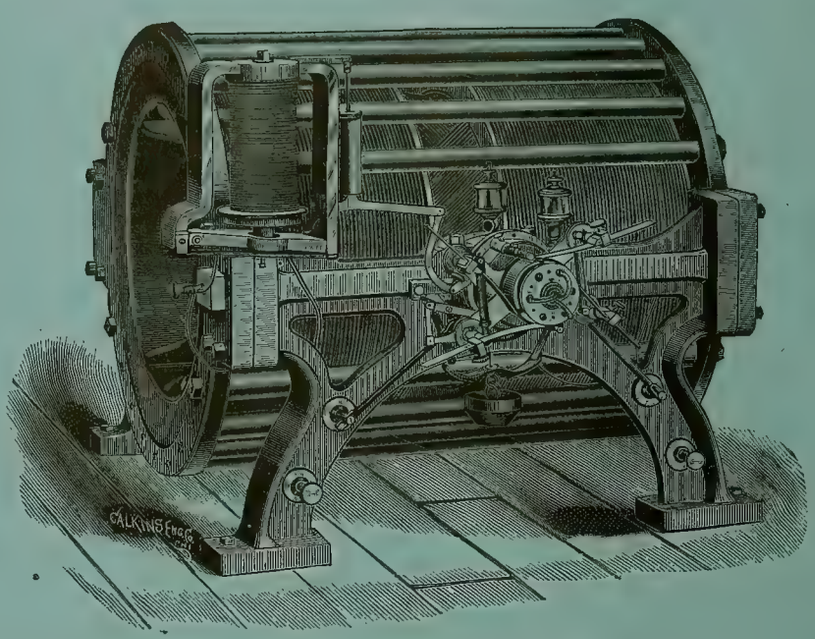

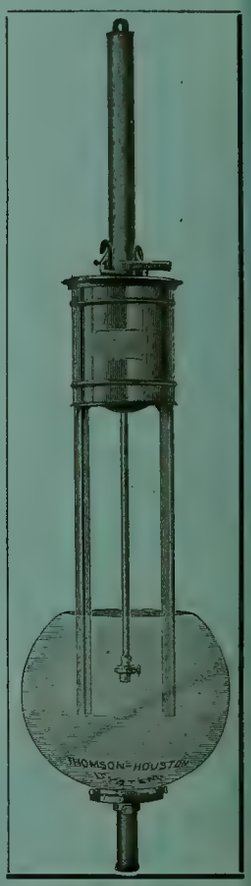

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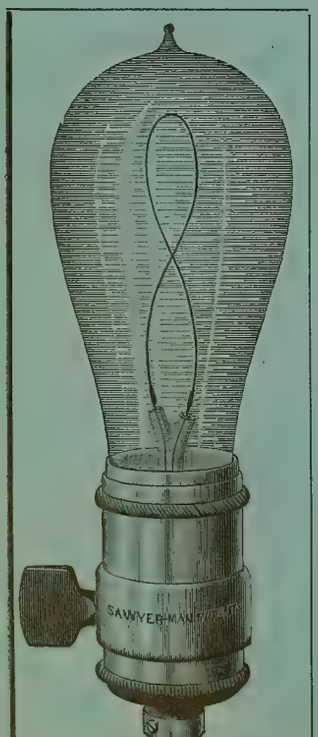
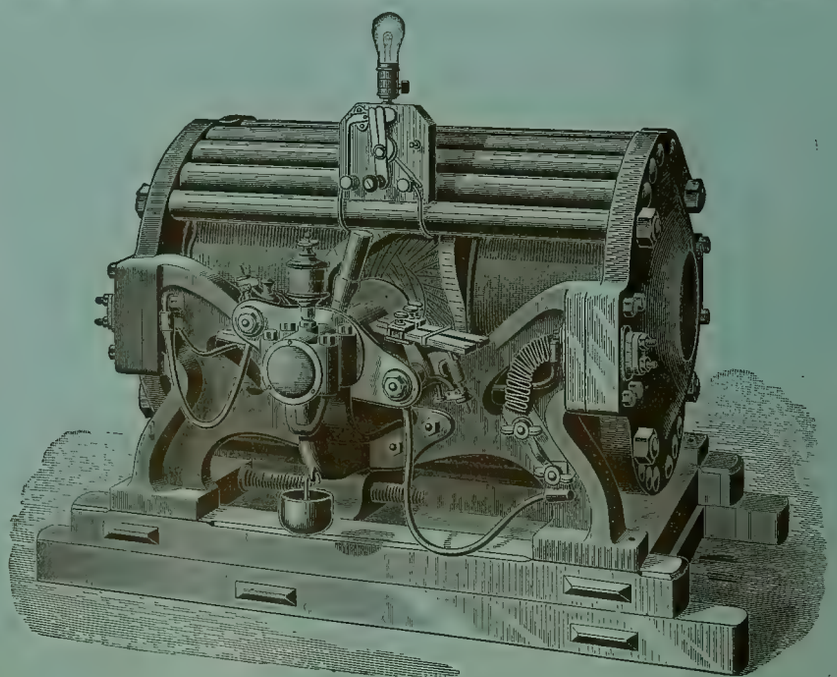
AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS.

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

Chicago & Northwestern R. R.

Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.

G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

LEONARD & IZARD, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(SIGNED) G. H. THAYER, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{60}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager. **219 LA SALLE ST., CHICAGO.**

Edison vs. The United States Electric Lighting Co.

This ad. occupies the same space occupied last week, and preceding weeks, by the Edison Company who stated that "THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF THOMAS ALVA EDISON, WHICH PATENTS ABSOLUTELY CONTROL," etc., etc. Upon another page of last week's issue of this Journal, issued after the United States Court's decision that in substance rendered THOMAS ALVA EDISON'S PATENTS ABSOLUTELY WORTHLESS, we notice the Edison Company only advertise themselves as "MANUFACTURERS and CONTRACTORS," etc., etc. *"What a fall was there my countrymen!"*

Before EDISON WAS BEATEN AT LAW and THE U. S. E. L. CO. became THE VICTORS, the Edison people went to the extreme length of saying that "the courts will soon render a decision which will knock the bottom clean out of the U. S. E. L. Co. and give Edison an absolute monopoly to incandescent lighting, and be a virtual extinction of the U. S. E. L. Co." Now after being beaten they will probably say "Oh this decision is not of much account anyway, you will hear from Edison again."

WHY NOT write to the Edison Electric Light Co. for their "Pamphlet on the Five Heads, PATENTS, INVESTMENT, FUTILITY of GUARANTEES, DANGER and MORAL," which in light of the present U. S. Court decision should read INVALID PATENTS, BAD INVESTMENT, FUTILITY OF EDISON GUARANTEES, DANGER AND MORAL.

The famous Red Book entitled "A WARNING FROM THE EDISON ELECTRIC LIGHT CO." (i. e. Fire Cracker) will now be laid upon the shelf alongside of other Ancient History,

THE VICTOR'S Chicago Address is,

THE UNITED STATES ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager Western Department. *THE ROOKERY, CHICAGO, ILLINOIS.*

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

JARVIS ENGINEERING COMPANY,

61 OLIVER ST. BOSTON. | 81 LAKE ST., CHICAGO. | 109 LIBERTY ST. NEW YORK.

H. A. GLASIER, Manager Western Dept.

CONTRACTING ENGINEERS FOR ERECTING COMPLETE STEAM PLANTS FOR

Electric Light and Power Stations

NATIONAL FEED WATER HEATER,
JARVIS BOILER SETTING, to burn Anthracite Coal and Coke Screenings
NATIONAL ROCKING and SHEFFIELD GRATE BARS.

SEND FOR NEW CATALOGUE.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

C F ANNETT, President. S. F. FENTON, Vice-Pres. and Treas. CHAS. S. SMITH, Secretary.

THE UNITED ELECTRIC COMPANY,

SALT LAKE CITY, UTAH.

DEALERS IN

ELECTRICAL APPARATUS AND SUPPLIES,

Hotel and House Annunciators, Electric Gas Lighting, Fire and Burglar Alarms, Electro-Medical Apparatus, Telegraph Instruments, Wire and Batteries.

ESTIMATES FOR ELECTRIC LIGHTING GIVEN ON APPLICATION

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

707 and 709 MARKET STREET, - ST. LOUIS.

Branch, Room 31 Water Works Building, 600 Walnut St., Kansas City, Mo.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

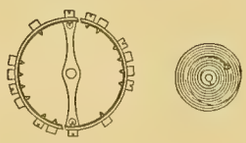
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

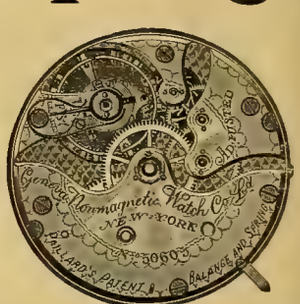
WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**



These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

FOR SALE BY ALL FIRST-CLASS JEWELERS.

SPECIAL ANNOUNCEMENT

—OF—

The Electrical Department

—OF—

THE NEW HAVEN CLOCK CO.

We have opened in Chicago the largest Electrical Department of Electrical Goods and Supplies of every description in the West.

Our Stock is very full and complete, and such as was never before offered in this section.

We particularly invite the attention of the trade to this fact, as the extraordinarily low prices in manufacturing our goods enable us to quote prices on same very much lower than current lists.

We invite correspondence for particulars and prices.

Included in this stock is a large lot of Annunciator Wire and Underwriters' Wire, which we shall offer in quantities at a price far below any we have seen or heard of.

Our quotations shall always be on a grade of goods in keeping with our high reputation as manufacturerers; we do not quote prices on inferior grades of goods.

We are now classifying our stock and compiling our catalogue, and any goods desired we will immediately quote you prices on. The occasion offers opportunities and prices rarely met with.

Any orders, either small or large, shall receive our prompt attention. Samples and Catalogues sent on application. Address,

315-321 Wabash Ave., CHICAGO.

NEW YORK. BOSTON. SAN FRANCISCO. LONDON. LIVERPOOL.

G. A. HARMOUNT, Western Agent.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

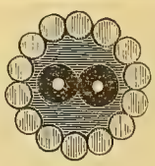
WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

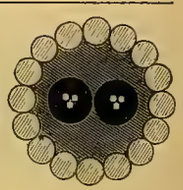
For Information relative to Central Station Business, apply to the

Edison Electric Light Co.,

16 & 18 BROAD STREET, NEW YORK.



High Insulation



In order to meet the constantly increasing demands for

BETTER INSULATION,

THE BISHOP GUTTA-PERCHA CO.

420-426 EAST 25th STREET, NEW YORK CITY,

HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

FOR MAKING THE CELEBRATED

HOOPER'S CORE

AND OTHER RUBBER COMPOUNDS

FOR INSULATING WIRES FOR

Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading-in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

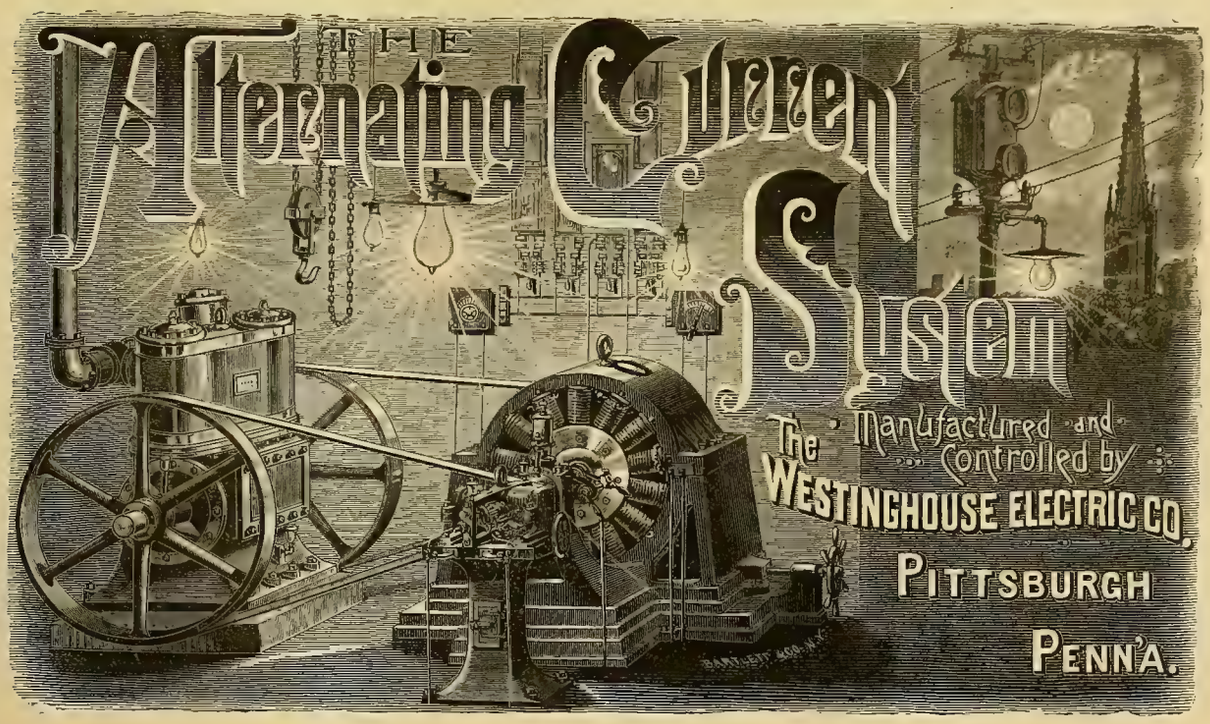
HENRY A. REED, Manager.

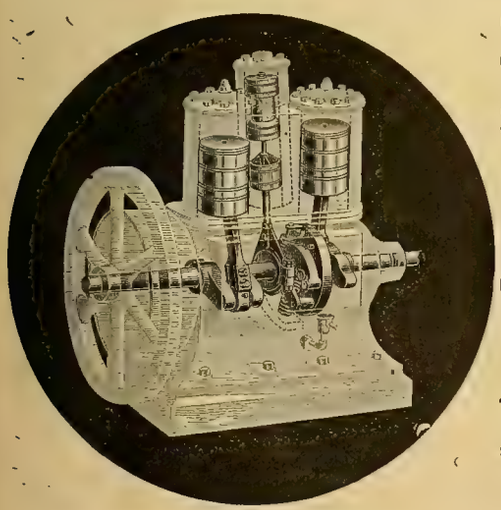
Use Marks' Compound Wire for Battery Coppers.

Use Balata Insulation for Flexible Cords.

USE NOTHING BUT

GUTTA-PERCHA FOR SUBMARINE CABLES.





DIVIDED POWER

SHAFTING { Costs to Purchase / Costs to Maintain / Costs to Lubricate / Costs to Drive } VERSUS THE **Westinghouse ENGINE.**

Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

THE AULTMAN & TAYLOR CO.,
Represented by ROBERTO BOKER & Co., City of Mexico, Mex.

Stevens, Corwin & Co., 118 Chambers St., New York City.
With houses in Panama, C. A., Lima, Buenos Ayres, Guayaquil and Valparaiso, S. A.

SELLING DEPARTMENT IN THE UNITED STATES CONTROLLED BY

WESTINGHOUSE, CHURCH, KERR & CO.
17 Cortlandt Street, New York. 97 Fifth Avenue, Pittsburgh.
156 and 158 Lake Street, Chicago.

M. R. MUCKLE, JR. & CO. (Rep. W., C., K. & Co.)
608 Chestnut Street, Philadelphia.

FAIRBANKS & CO.
302 & 304 Washington Ave., St. Louis. 312 Union Ave., Kansas City.
1330 Seventeenth Street, Denver.

F. C. AYER. (Representing F. & Co.)
1619 Capital Avenue, Omaha.

GEO. M. DILLEY & SONS. (Reprcsenting F. & Co.)
Pine Bluffs, Arkansas.

UTAH AND MONTANA MACHINERY CO.
259 South Main Street, Salt Lake City.
East Granite Street, Butte, Montana.

PARKE & LACY.
2123 Fremont Street, San Francisco.
33 and 35 North Front Street, Portland, Or.

THE D. A. TOMPKINS CO.
36 College Street, Charlotte, N. C.
45 South Pryor Street, Atlanta, Ga.

ROBT. MIDDLETON. (Representing The D. A. T. Co.)
Mobile, Ala.

H. DUDLEY COLEMAN & CO. (Rep. The D. A. T. Co.)
New Orleans, La.

KEATING IMP. & MACHINE CO. (Rep. The D. A. T. Co.
Dallas, Texas.

J. J. DICKEY, President. ISRAEL LOVETT, FLEMON DRAKE, Vice President.
H. J. WELLS, Sec'y and Gen'l Man. Sup't and Electrician. L. H. KORTY, Treasurer.

MIDLAND ELECTRIC CO.,
OMAHA, NEBRASKA.
——DEALERS IN——
ELECTRICAL SUPPLIES
For the Telegraph, Telephone and Electric Light.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learners' Instruments, Medical Batteries, Linemen's Tools, Bell Hangers' Supplies, Railway Velocipedes, Cars, Etc.

WESTERN AGENTS THE OKONITE CO., and the Return Call System of Hotel Annunciators. Fire Alarms for Cities and Towns. We own the Franchises of the Western States and Territories for the

IMPROVED McCULLOH
AMERICAN DISTRICT TELEGRAPH SYSTEM,

and are prepared to give franchises and construct plants on reasonable terms.

☞Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

The Empire City Electric Co.

15 DEY STREET,

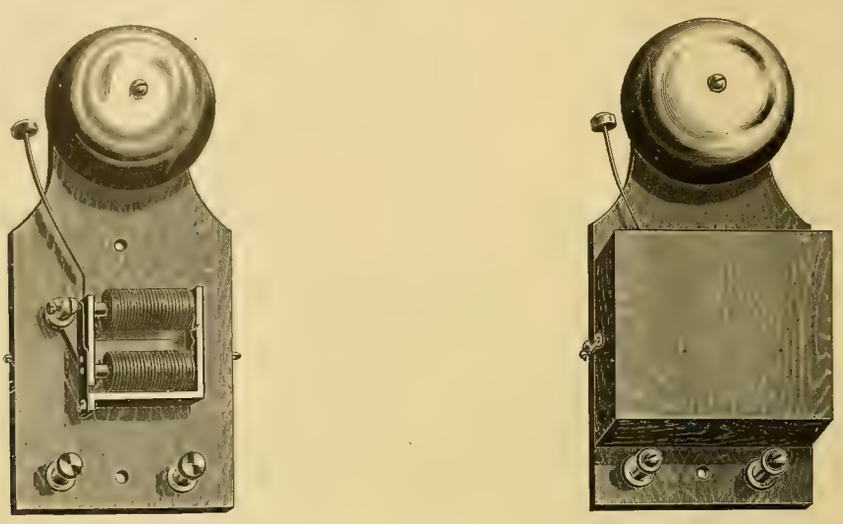
NEW YORK,

Manufacturers and Dealers

IN ALL KINDS OF

ELECTRICAL SUPPLIES.

ELECTRIC BELLS



THE ABOVE CUTS REPRESENT THE

Western Electric Walnut Box Bell.

The workmanship and finish being up to our usual standard is a guarantee that it is the best Bell for the money now upon the market.

EACH BELL PACKED IN NEAT PASTE BOARD BOX.

DIMENSIONS.

Back,	7 x 3 1-8 in.
Box,	3 1-8 x 2 13-16 x 1 1-5 in.
Resistance,	3 to 4 ohms.

We will send a sample Bell to any part of the United States by mail, postage prepaid, on receipt of seventy-five cents.

SPECIAL PRICES ON QUANTITIES FURNISHED ON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, JUNE 2, 1888. No. 22.

Armature Protector.

This is the name given a new electrical device by C. D. Wright, of Petersburg, Ill., the inventor, illustrated by the accompanying cut. The purpose of the instrument is to provide an resistance which will be thrown into circuit to take the place of a number of lights that may suddenly be cut out and to protect the armature from the evil results of a short circuit. The instrument illustrated does not show the resistance coils as they can be of any form.

Referring to the engraving the current enters at the upper right hand binding post H, passing through the magnet C, the arm D, to the post G, and then to the line. The weight A is adjustable and can be set at any place on the beam which will adjust the armature B to the strength of the current when the dynamo is working with its normal load. Should the dynamo by any means become short-circuited the increased current strength will energize the magnet C and attract the armature B with sufficient force to release the arm D which will fly down, making a contact in the hook shown in lower left hand corner. The circuit will now be from binding post H to lower right hand binding post, through resistance coil not shown, to arm D shown by dotted lines, to binding post G and then to line. Thus the resistance will be thrown in between the two lower binding posts sufficient to prevent the armature of the dynamo from being injured.

When the arm D falls to the perpendicular position indicated by the dotted lines, it closes a local circuit through the spring F, insulated from the arm D. In this local circuit is a bell which when rung attracts the attention of the dynamo tender.

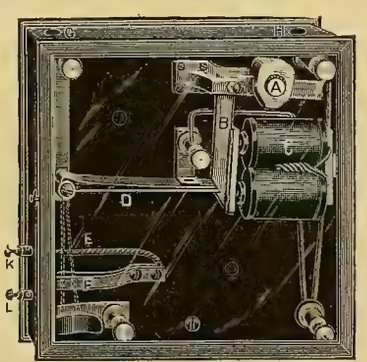
Failure of the American Electric Manufacturing Company.

The business of the American Electric Manufacturing company of New York was attached by the sheriff last week. A dispatch from New York says the attachment was made on ten judgments, aggregating $19,419, in favor of the American Electrical works of Providence. The cause of the failure was inability to secure ready money. The company was incorporated in 1885, with a capital of $3,000,000 of which $1,000,000 was paid in stock to the American Electrical and Illuminating company of Boston. Only a small percentage of the capital stock was paid in and the company has been constantly hampered by the lack of funds with which to carry on the business. The officers realized some little time ago that a crisis was at hand, as the capital had been exhausted and the stockholders, in spite of the fact that a fairly good business was being transacted, refused to put in more money.

It is expected that the company will be able to extricate itself from its present position, and it is said capitalists with plenty of money are figuring to obtain control of the concern.

Death of Sir Charles Bright.

Sir Charles Bright died the 3d inst., at his residence in London. His greatest achievement was in connection with ocean telegraphy. The late Mr. Crampton, by his cable across the Channel, had shown that signals could be transmitted across the sea; but it was reserved to Charles Bright to conceive the idea of laying a cable under the Atlantic to join the old world with the new. This was after he had successfully laid the first cable which united Great Britain with Ireland in 1853. He had been experimenting for some time on a system of insulating wires with gutta-percha, and the success with an experimental circuit 2,600 miles in length led to the conviction that telegraphic communication with America was possible. The idea at first met with but little favor with capitalists in New York and Boston, whom Mr. Field tried to interest in the scheme. Mr. Field came over to England in 1856, and entered into an agreement with Mr. Brett, Mr. Whitehouse and Mr. Charles Bright, who at that time was the engineer of the Magnetic Telegraph company. Under this agreement, each of these promoters was mutually bound to push on the undertaking in every possible way, and to share in the ultimate profits. Charles Bright and his friends raised the capital necessary for the first Atlantic cable, which was successfully laid by him in 1858, he being then the engineer in chief to the company. He designed the paying out machinery, and the other mechanical appliances required for the submergence of the cable. Associated with him were Sir Samuel Canning, H. Woodhouse, H. Clifford, F. C. Webb and Sir William Thomson. The two thousand miles of cable required were made in England, and in the laying there were employed four ships lent by the British and the United States Governments. After the great services thus rendered to ocean telegraphy, Mr. Bright was



knighted by the Lord Lieutenant of Ireland. Sir Charles Bright was next engaged in submarine telegraphy in the Mediterranean and the Baltic, after which he was summoned in 1864 by the Government of India to complete the telegraphic communication with Europe, which work he accomplished by joining Kurrachee with the northern end of the Persian Gulf. He subsequently superintended the laying of cables between the United States and Cuba, and was also engaged in the erection of telegraph lines between various parts of North and South America. Sir Charles Bright was elected a member of Parliament for Greenwich in 1865, and represented that constituency for several years in the liberal interest. In 1881 he was appointed by the Foreign Office one of the commissioners to represent Great Britain at the Electrical Exhibition at Paris, and he was afterwards nominated by the French Government an officer of the Legion of Honor. In 1865 he contributed a very important paper to the Institution of Civil Engineers, in which he advocated submarine telegraphy to China and to Australia, and the paper received a Telford medal and premium.

Electric Current Not Dangerous.

W. H. Preece in a recent course of simple lectures on the applications of electricity before the London Society of Arts said a number of good things which are well worth reproducing. Speaking of the danger of the current with which he was experimenting, he said: "The current is supposed to be a very dangerous one; in reality it is not; there is no electric current that has ever been produced that is one-tenth as dangerous as a steam boiler, and all these currents, however immense they may be, are very simply controlled, and very easily brought within the region of safety. There is no doubt that with the apparatus that is now being handled in this room, if anybody were deliberately to put one wire in his mouth, and the other in his hand, he would have the funeral service performed over him in two or three days, but those who know what they are about no more handle electric light wires carelessly than they put their hands in a furnace or their noses in boiling water. We acquire experience by practice, and we know by this time pretty well how to deal with electric currents." Of the advantages of the electric light he said: "I will not attempt to occupy your time in speaking of the beauties of this wonderful light, how it removes really poison from our air, how it is very good for sore eyes, because it burns with such steadiness that those who work under it really never find, in any shape or form, any inconvenience or discomfort to the eyes. It is extremely cleanly; it does not fill the air we breathe with obnoxious fumes. People are little aware of it, but it is a very simple calculation to show that thirty gas burners produce a gallon of water in an hour, so that if you have thirty burners in a shop, for instance, alight for six hours, six gallons of water are produced, and the water can very often be seen running down the cold windows of shops. That water absorbs sulphur and sulphuric acid, and when deposited on books and decorations destroys them. If we could only get the electric light cheap, delivered at our doors, then everybody who has an idea of luxury and comfort would at once take it."

In order that he might have a reading lamp in the dismal, poorly lighted English compartments, he spoke of a lamp he used as follows: "I travel a good deal, and I always carry in my traveling bag a battery like this, which is one of Pitkin's secondary batteries. It is light and extremely convenient; I can strap it on my shoulder like an opera glass. To this is attached a reading lamp which I fix in my waistcoat, and to the astonishment of my fellow travelers, when the shades of evening are beginning to set, I take out the lamp and put it in operation so. My reading lamp is thus provided, and it is fixed in the most convenient position, for the light falls just where it is wanted, it does not offend the eye, and enables me to read the smallest print. I have always got with me my own light, perhaps much to the annoyance of my fellow passengers, and with the electric light machinery at my own house, I have little or no trouble in recharging the battery, or keeping it in order."

Thomson-Houston Company's New Offices.

The Thomson-Houston company is now fairly settled in its new quarters, at 148 Michigan avenue, Chicago. The company's business has been remarkably large, and new offices affording additional facilities for its transaction were imperatively demanded. In the new location everything which could contribute to the elegance and convenience of offices has been provided, and the comfort of customers has not been neglected. The ceilings are high, and all the rooms are airy, light and cheerful. The furnishings in all the

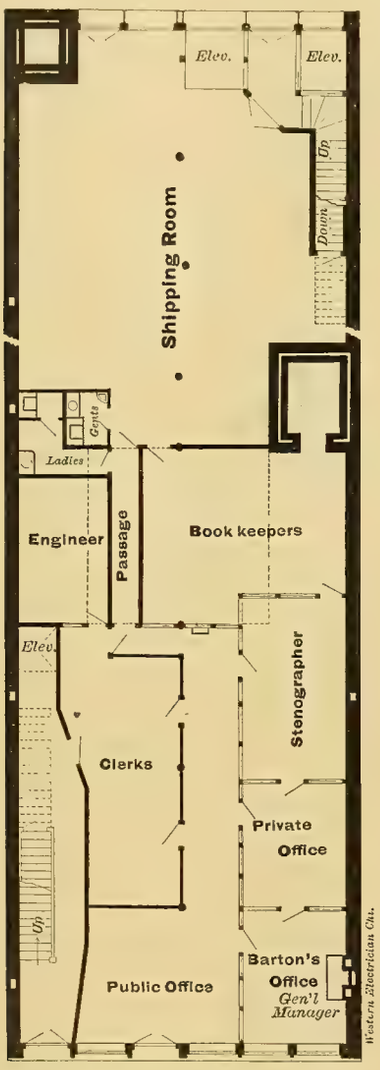
departments are elegant and in marked good taste.

The dimensions of the first floor of the building on which the offices are located are 160 feet by 40 feet. A cut of the ground plan is herewith given. On the left as one enters the building is the public office, which is tastefully furnished. Adjoining on the same side of the room are the clerks' offices.

A high partition on the right of the room separates the private offices from the public portion of the room. The first room, which is a veritable little parlor, is occupied by General Manager Barton.

The second office is a reception room. It is furnished elegantly, and is intended for the use of customers.

The third office is that of Daniel B. Stedman, treasurer of the company. Adjoining Mr. Stedman's office is the bookkeeper's department, which is fitted up with every facility for the transaction of business. As will be seen by



reference to the cut, this room communicates with the open office by a window.

To the right of the bookkeeper's room, just across a passage way, is a cosy little room intended for the use of the engineer. In a little room adjoining is the telephone. The rooms thus briefly referred to are all which the general visitor to the establishment has an opportunity to see. They are well worth seeing, and a large number of callers have expressed their admiration of their elegance and convenience. But a representative of the WESTERN ELECTRICIAN had an opportunity of making a more extended visit.

In the rear of offices is the shipping room, the dimensions of which are 40x96 feet. A large stock of goods is kept in stock here. Bins to the number of 1,500 are employed for storing the various articles in stock. An overhead rail is used in transferring heavy machinery to and from wagons at the doors in the rear.

Not the least interesting part of the new building of the company is the basement. Light enough is wasted there to illuminate a mile of street. At the rear of the room is a 45-arc light dynamo, which supplies the incandescent lights now used in the building. A line of arc lamps is used to take a portion of the load, as the output is not consumed by the incandescent lamps. The dynamo is driven by a Phœnix engine, which runs at the rate of 275 revolutions per minute. A large number of arc lamps is also tested in the basement, and these add to the general illumination.

Several machines to be used in making repairs are in the basement. They will be run by motors as soon as the plant can be fitted up. The plant will then be splendidly equipped, and will exhibit very handsomely the working of all appliances embraced in the Thomson-Houston system.

There are two boilers in the basement, each of 80 horse power. One of the furnaces is manufactured by the Jarvis company, and the other is of McGinnis' make.

There will be other departments in the building when the work is completed. On the second floor will be a large light room for the use of draughtsmen.

The Transmission of Electric Power.

BY HERR COERPER, MANAGER OF THE HELIOS ELECTRICAL COMPANY AT EHRENFELD, COLOGNE.

The employment of electrical propulsion for cars is more and more drawing to the front. In America already in twenty towns there are electrical railways being worked. In England extensive trials are being made. On the European continent some lines are in activity a long time since already, and last year the general attention of tramway companies was called to electrical gear, as the most convenient, elegant and cheapest means of locomotion, by an address by M. Mickelet at Brussels.

According as the electrical energy shall be supplied to the car in motion from outside, or be carried along with it in storage batteries, there are three questions to be solved. In the former case these are to be ascertained: the best way of supplying the current, the best construction of the motor and a reliable kind of transmission between motor and car. In the second case these are to be found out, the best accumulator, motor and transmission gear. The supply of current to the car shall not be considered here. I only intend to submit some remarks on the motor kind of transmission and accumulators.

Hitherto, almost exclusively, dynamos of high speed of the most varied construction have been employed as motors. The same are usually fastened to the car frame, and they transmit their power to the axle of the car by means of toothed wheels, friction wheels, belts, chains, wire spirals, worm-wheels, gearing, etc. Immish & Holt fasten the motor to the axle of the car, which is immovable whilst the wheels run upon collar-boxes. The one wheel is connected with a toothed crown wheel, into which the small tooth wheel upon the axle of the dynamo fits. This gearing, however, does not answer, and in consequence a new method shall now be tried. From the search after the best construction of the motors, and the changing variety of ways of transmission, it can easily be recognized that a thoroughly satisfactory solution of these questions has not been found as yet. The reason for this lies in the nature of the matter itself. Only in the rarest cases with electrical tramways an uninterrupted run to a strictly defined distance can be taken into account. In such cases the arrangement as it exists in the line near Schwabing may conveniently be resorted to, where the car at the terminus runs up a rising 18 meters long, is arrested at the top and, when restarting, attains, by running down freely from the higher situated point, a greater velocity before the electro-motor is set at work. Mostly, however, a similar arrangement is impossible because the car is obliged to frequently stop and restart, without any regard to the construction of the line. Then the greatest efforts under the most unfavorable circumstances are asked from the motor. A firm coupling between motor and the axle of the car, for mechanical reasons, appears unavoidable, be it by tooth wheels, belts, worm wheel gearing or similar means.

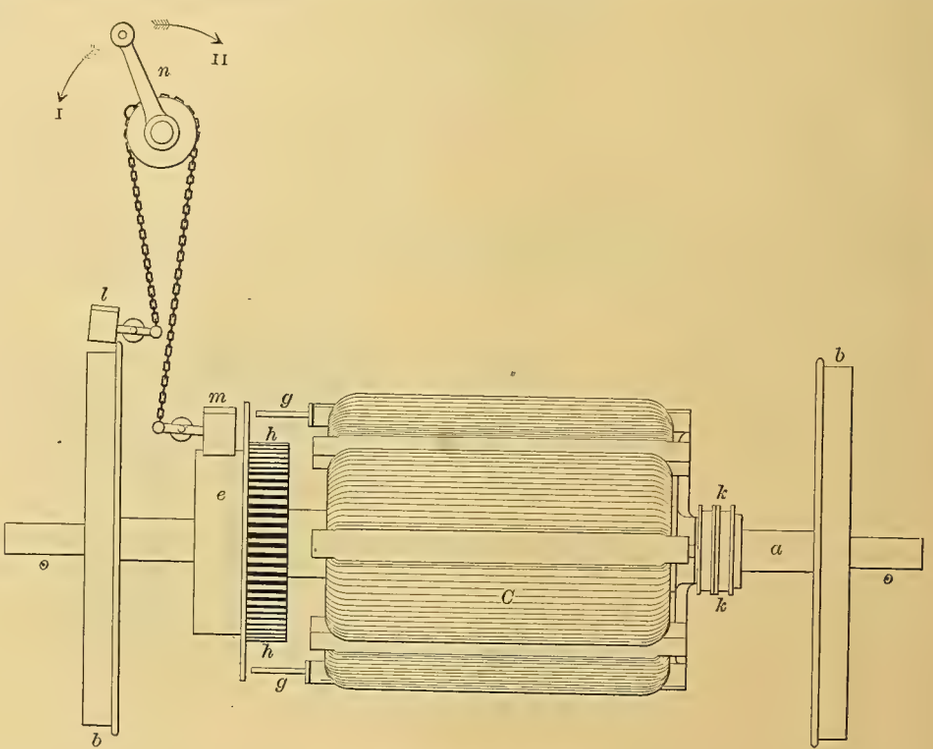


FIG. 1.—HELIOS ELECTRIC MOTOR.

Trials which were executed upon a line which was in the very best state and perfectly horizontal, have now resulted in proving, that a certain car, which, when in motion, will go over a distance of five meters per second with a traction-force of 120 kilogramme-meter-seconds, requires 345 kilogramme-meter-seconds for starting. With a worse state of the line, with risings, in curves, or when unevenly loaded, this relation becomes considerable and quite out of proportion. The electrical motor consequently, in order to comply with the requirements of workings, ought to develop the greatest power when starting. This, however, with all constructions hitherto devised, is not the case. If the current, when the car stops, is made to circulate, the motor, in consequence of its firm coupling with the propelling axle, cannot but start very slowly. The supply of current, although such an excessive one, that the isolation is endangered and the fire upon the commutator becomes rather critical, nevertheless yields to the motor but a small fraction of the power which it develops

with the normal number of revolutions and less current. The electrical tramway, as it has hitherto been constructed, therefore starts under the most unfavorable circumstances, and only when a certain speed of the car has been reached, the motor works with little current and greatest power. This, again, however, is just the stage of the working where the least force is necessary.

Furthermore, an inconvenience of the present arrangement arises from the mode of transmission. It is well known how great the loss of power of worm-wheel and tooth-wheel gearing is; not much less is the same with chain and friction gearings. The rapid depreciation of the single parts of such constructions, though made of the hardest and toughest material, sufficiently proves what power is lost thereby. Belts, wire spirals, etc., also show a considerable loss of force. This loss becomes the heavier the greater the speed of the motor. The inferior safety of the working offered by the accustomed modes of transmission, is also to be considered. It is known that interruptions are daily occurrences, that the expenses of repairs are very considerable, and that the interruptions of the working consequent upon the failure of the arrangements for transmission are regularly being attributed to the electrical parts generally, and not to the defective mechanical arrangements.

If we resume the practical results of the constructions hitherto used, we find that the motor must work under the most unfavorable circumstances when starting; that it has the least power and requires the most current when it requires the greatest power; that it develops the greatest power when it requires the least; that the mode of transmission entails a considerable loss of force, which happens to be greatest just when the least power is necessary; and that the mode of transmission is not only insecure, but also detrimental and very expensive.

If the propulsion takes place by accumulators, then the frequent damage which they are exposed to is to be taken into account. An accumulator is almost undestroyable, if the same is correctly charged and uncharged. Every possible effort has been made to improve the accumulators, so as to make them fit for being used for tramways. However, with no reason whatever. Every good accumulator is perfectly suitable for this purpose. It is only necessary to not overdo it unreasonably. This, however, as long as the present constructions of motors and transmissions are being employed, always takes place as a matter of course.

Nothing hurts the accumulator more than a short circuit. When starting, however, if the dynamo, as heretofore, is firmly coupled with the propelling axle, the accumulator is in perfectly short circuit because the current which feeds the firmly fixed dynamo is only moderated by the resistance of the copper, and not by the counter electromotive force, which the dynamo displays when it runs with the normal number of revolutions. It is an easy matter for the present state of the technical science to construct an accumulator for a run of 50 kilometers and to place it upon a car, but it is a thoroughly useless endeavor to improve the accumulator so as to make it stand being exposed to a short circuit, perhaps 50 to 100 times during a 50-kilometer run, as the working requires. Hereby the accumulators simply get disordered, just as well as the dynamo gets overheated and its commutator damaged by the fire on the brushes.

All these circumstances, which under the present arrangements offer the very contrary of what the electric working of railways needs, point with unresistible force to a fundamental change of the constructions, if the future shall belong to the electric railway. If there were no electric railways existing, the machine maker would perhaps propose the following programme:

1. The motor must, according to the requirements of the working, display its maximum power when the car shall start.

2. The transmission by means of worm-wheel gearing, tooth-wheel gearing, chains, etc., can not be admitted on account of the great wear and tear, the insecurity of the working, and the loss of force.

3. The accumulator and the motor must not be exposed to short circuits, because thereby the accumulator is destroyed, and the motor becomes endangered by overheating and by fire upon the accumulator.

From these points of view, the arrangement as subsequently described here has been constructed. It can be readily understood by careful observation of the reference letters on the accompanying cuts.

The magnetic field of the dynamo C, is fixed upon the axle of the car (the propelling axle) itself, so that a turning of the magnetic field also involves a turning of the axle of the car. The armature shaft *d*, with the brake-disk *e*, is placed on a ram's-eye *f*, which, by means of collar boxes, easily turnable, is mounted upon the propelling axle. The magnetic field bears the grinding-springs *g*, where, as underneath these grinding-springs (*g*), the commutator *h* is fastened to the brake-disk, firmly connected with the armature shaft. Upon the outer ram's-eye of the brake-disk *e* there are placed two grinding-rings *i*, by which the current is conducted to the armature, whilst near the magnetic field C, upon the propelling axle, there are likewise placed grinding-rings (*k*), by which the conduct of current to and fro the magnetic field takes place. Upon the magnetic-wheel *b* and the brake-disk *e* a speed-reducing gear, *l* and *m*, is attached, which by means of a lever *n* is handled by the engineer of the car. If the lever (*n*) is turned to the left (I), then, by pushing the brake-block *m* against the brake-disk *e*, the brake-disk *e* and the armature, connected therewith, is arrested; vice versa if the lever is turned to the right (II), then the car-wheel *b* becomes arrested, the brake-disk *e*, connected with the armature, is completely liberated, allowing the armature to turn perfectly freely. According to very accurate trials made by myself, an electro-motor fitly constructed now makes, with uniform supply of current and equal display of force, the same number of revolutions, no matter whether the magnetic field or the armature is made to turn. If armature and magnetic field are left to run simultaneously, both only make half the number of revolutions, while running in opposite directions. If, therefore, the propelling axle (*a*) rests in boxes *o*, one can, by arresting the armature *d*, make the propelling power be exercised by the magnetic field *c* alone, or one can, by moderating the speed of revolutions of the armature *d*, give to the magnetic field *c*, and along with it to the propelling axle *a* proportionate velocity.

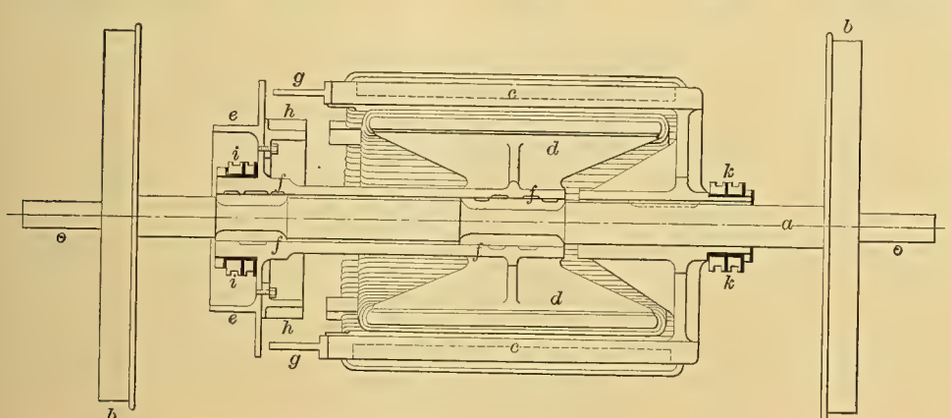


Fig. 2.—Helios Electric Motor.

The effect now of the described arrangement is as follows: When the car stops, the brake upon the car must have been racked. Hereby the brake-disk *e* and the armature *d* are liberated. If the current circuit is now closed the armature will at once attain its normal speed, because it can turn perfectly freely. A short circuit of the machine, or the accumulators, is therefore impossible. If the armature has its normal speed, the dynamo also develops its greatest power with proportionately little consumption of current. Should the car now be started, the engineer must let the car-wheel be free. He therefore turns the brake-lever to the right. Hereby he arrests the brake-disks *e*, and with it the armature *d*. In the same proportion, however, as the speed of the armature *d* is slackened, the magnetic field *c* commences to turn, viz., in the opposite direction, so that finally when the brake-block *m* completely arrests the brake-disk *e*, and with it the armature *d*, then the magnetic field *c* alone propels the car with normal velocity. Should it be stopped, the engineer must turn the brake-lever to the left (I). Thereby he unties the armature; and because the same at once tends to take up the normal speed, not having to exercise any power, the traction force of the magnetic field at once ceases, and the brake can without hindrance stop the car-wheel.

It is clear, that the braking gear can be varied in the most manifold manner, also be replaced by conical and other brakes. The predominating idea of this arrangement always remains this: *The firm connection of one of the elements of the machine with the propelling axle and the freely moveable arrangement of the other element of the dynamo machine, controllable by a special braking gear.* The driving forward and backward is effected by changing the direction of the current to the armature.

If we examine how far the described constructions responds to the programme set up we find:

1. The motor obtains when the current is closed, even if the car stops, at once its normal speed. It disposes, therefore, of its maximal power, at the moment when the car, by pressing the brake upon the armature braking disk, shall start.

2. All intermediate gearing for transmission is obviated, because the motor is fastened to the car axle itself and because it has the same velocity as the propelling axle.

3. Neither the accumulator nor the motor can be exposed to a short circuit when starting, because, before being able to do so, the brake on the braking disk of the armature must be opened mechanically, and because the armature afterwards is not in any way hampered to at once assume its normal speed.

Against this construction there can be objected that the brushes or gliding springs must turn round along with the magnetic field, and that the dynamo, because fastened to the propelling axle, can have but an inferior velocity, and consequently thereupon have but inferior efficiency. The first objection appears futile, because, while the train runs, it would not be possible to attend to the brushes. It does not matter, therefore, whether the same move or are fixed. The second objection leads at once into the syllabus of modern electro-technic, of which one dogma proclaims: "Slow speed dynamos notoriously have less efficiency than quickly going ones." I always ask which dynamos? The slowly going dynamos, built by the Society Helios at Ehrenfelt, Cologne, for 80 to 120 revolutions per minute, according to my construction, all possess an electrical efficiency of more than 90 per cent. When running they hardly get warm. The copper winding is, when exerted maximally charged with but about 1 to 1.5 amperes per square millimeter sectional area of copper. The indicator diagrams of the steam engines taken from Helios engine sets (steam engine and dynamo) of 80 and 100 horsepower give a very high number of volt amperes per horsepower indicated, when normally loaded. As, however, there stand considerable difficulties in the way, for indicating the effects, when not loaded, I will desist for the present from giving a precise result of the effective horsepower. Anyhow I maintain, not without reason, that no quickly turning dynamo gives a

better commercial result. Measurements taken from two or three little machines, I esteem to be to no purpose. Especially, if according to the maker's own publication, the "best and most simple dynamo construction in the market" works with a charge of the copper windings of 8.5 amperes pro. 1 sq. mm. sectional copper area. The philosophizing on lightness of currents, etc., in order to account for cheap and "bad" constructions, I regard as useless. For the present the law of Ohm still rules, and according to that the quantity of currents in all parts of a closed conductor is everywhere the same. According to my own practical tests, a copper wire bobbin of 203 mm. wire, when a current of 35 amperes passes it, becomes so hot that it can hardly be touched. It requires, therefore, a strong fidelity of faith, if thus constructed dynamos, which, in addition make 1,200 revolutions, are not only mentioned in one breath with Helios machines, but as regards their efficiency are represented as far superior to the latter. It must always be asked, what machines are referred to? And as no electrician who will boldly state that

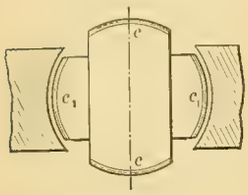


Fig. 1.

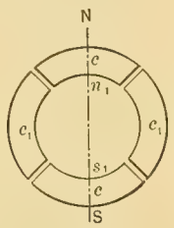


Fig. 1a.

quickly going machines are better than slowly going ones, has as yet taken the trouble to accurately examine one of the numerous practical executions of Helios, I think I have the right to say that the assertion, that high speed generally gives a better commercial efficiency, than a small number of revolutions, belongs to the domain of idle fallacies.

As things are, the objection against the employment of the slowly going dynamos, mounted upon the propelling axle of a car, can fittingly be brought forward only when a bad construction is concerned. This arrangement is, however, quite unobjectionable when a good machine, fit for the purpose, is being used. In a given case, which is represented in the accompanying drawings generally, the propelling axle of a street tramway is made the object. The diameter of the wheels is 750 mm. the circumference therefore, 2.35 meters. The car shall run

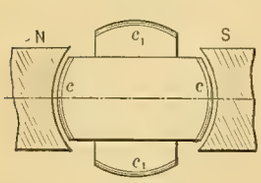


Fig. 3.

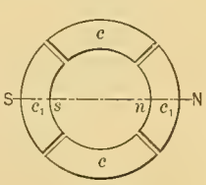


Fig. 3a.

300 meters per minute, from which there results a speed of 125 revolutions per minute. The dynamo for this number of revolutions is calculated as a current originating machine in series of an electrical efficiency of 86 %. I hardly believe that anyone, after examination of the relative circumstance in practice, would maintain that this arrangement, with the slowly-going machine, gives an inferior commercial efficiency to any other (quickly-going) dynamo, the power of which must be transmitted by tooth wheels, worm wheels, chains, etc., from the axle of the armature upon the propelling axle.

I am of opinion that only the plainest views concern the construction of machines can lead to practically good solutions on the field of electro- technics. The chief condition is to furnish good mechanical installations and arrangements. The race and the haggling about fractions of percentages of efficiencies have little value for practical purposes.

So I believe that the introduction of electrical railways will, notwithstanding right or wrong academical considerations on efficiency, be furthered by the here described simple arrangements.

A New System of Alternate Current Motors and Transformers.[1]

By Nikola Tesla.

PART I.

In the presence of the existing diversity of opinion regarding the relative merits of the alternate and continuous current systems, great importance is attached to the question whether alternate currents can be successfully utilized in the operation of motors. The transformers, with their numerous advantages, have afforded us a relatively perfect system of distribution, and although, as in all branches of the art, many improvements are desirable, comparatively little remains to be done in this direction. The transmission of power, on the contrary, has been almost entirely confined to the use of continuous currents, and notwithstanding that many efforts have been made to utilize alternate currents for this purpose, they have, up to the present, at least as far as known, failed to give the result desired. Of the various motors adapted to be used on alternate current circuits the following have been mentioned: 1. A series motor with subdivided field. 2. An alternate current generator having its field excited by continuous currents. 3. Elihu Thomson's motor. 4. A combined alternate and continuous current motor. Two more motors of this kind have suggested themselves to me. 1. A motor with one of its circuits in series with a transformer and the other in the secondary of the transformer. 2. A motor having its armature circuit connected to the generator and the field coils closed upon themselves. These however, I mention only incidentally.

The subject which I now have the pleasure of bringing to your notice is a novel system of electric distribution and transmission of power by means of alternate currents, affording peculiar advantages, particularly in the way of motors, which I am confident will at once establish the superior adaptability of these currents to the transmission of power and will show that many results heretofore unattainable can be reached by their use — results which are very much desired in the practical operation of such systems and which cannot be accomplished by means of continuous currents.

Before going into a detailed description of this system, I think it necessary to made a few remarks with reference to certain conditions existing in continuous current generators and motors, which although generally known, are frequently disregarded.

In our dynamo machines, it is well known, we generate alternate currents which we direct by means of a commutator, a complicated device, and, it may be justly said, the source of most of the troubles experienced in the operation of the machines. Now, the currents so directed cannot be utilized in the motor, but they must — again by means of a similar unreliable device—be re-converted into their original state of alternate currents. The function of the commutator is entirely external, and in no way does it affect the internal working of the machines. In reality, therefore, all machines are alternate current machines, the currents appearing as continuous only in the external circuit during their transit from generator to motor. In view simply of this fact, alternate currents would commend themselves as a more direct application of electrical energy, and the employment of continuous currents would only be justified if we had dynamos which would primarily generate, and motors which would be directly actuated by such currents.

But the operation of the commutator on a motor is twofold; firstly, it reverses the currents through the motor, and secondly, it effects automatically, a progressive shifting of the poles of one of its magnetic constituents. Assuming, therefore, that both of the useless operations in the system, that is to say, the directing of the alternate currents on the generator and reversing the direct currents on the motor, be eliminated, it would still be necessary, in order to cause a rotation of the motor, to produce a progressive shifting of the poles of one of its elements, and the question presents itself, how to perform this operation by the direct action of alternate currents. I will now proceed to show how this result was accomplished.

In the first experiment a drum-armature was provided with two coils at right angles to each other, and the ends of these coils were connected to two pairs of insulated contact-rings as usual. A ring was then made of thin insulated plates of sheet iron and wound with four coils, each two opposite coils being connected together so as to produce free poles on diametrically opposite sides of the ring. The remaining free ends of the coils were then connected to the contact rings of the generator armature so as to form two independent circuits, as indicated in Fig. 9. It may now be seen what results were secured in this combination, and with this view I would refer to the diagrams, Figs. 1 to 8*a*. The field of the generator being independently excited the rotation of the armature sets up currents in the coils *c c*, varying in strength and direction in the well known manner In the position shown in Fig. 1 the current in coil *c* is nil while coil *c'* is traversed by its maximum current, and the connections may be such that the ring is magnetized by the coils *c c*, as indicated by the letters *N S* in Fig. 1*a*, the magnetizing effect of the coils *c c* being nil, since these coils are included in the circuit of coil *c*.

In Fig. 2 the armature coils are shown in a more advanced position, one-eighth of one revolution being completed. Fig. 2*a* illustrates the corresponding magnetic condition of the ring. At this moment the coil *c* generates a current of the same direction as previously, but weaker, producing the poles n_1 s_1 upon the ring; the coil *c* also generates a current of the same direction, and the connections may be such that the coils *c c* produced the poles *n s*, as shown in Fig. 2*a*. The resulting polarity is indicated by the letters *N S*, and it will be observed that the poles of the ring have been shifted one-eighth of the periphery of the same.

In Fig. 3 the armature has completed one quarter of one revolution. In this phase the current in coil *C* is a maximum, and of such direction as to produce the poles *N S* in Fig. 3*a*, whereas the current in coil c_1 is nil, this coil being at its neutral position. The poles *N S* in Fig. 3*a* are thus shifted one-quarter of the circumference of the ring.

Fig. 4 shows the coils *c c* in a still more advanced position, the armature having completed three-eighths of one revolution. At that moment the coil *c* still generates a current of the same direction as before, but of less strength, producing the comparatively weaker poles *n s* in Fig. 4*a*. The current in the coil *c* is of the same strength, but of opposite direction. Its effect is, therefore, to produce upon

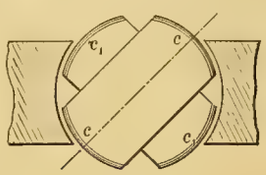


Fig. 2.

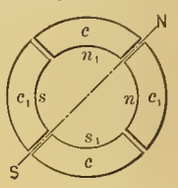


Fig. 2 a.

the ring the poles n_1 and s_1 as indicated, and a polarity of *N S* results, the poles now being shifted three-eighths of the periphery of the ring.

In Fig. 5 one-half of one revolution of the armature is completed, and the resulting magnetic condition of the ring is indicated in Fig. 5*a*. Now, the current in coil *c* is nil, while the coil *c* yields its maximum current, which is of the same direct on as previously; the magnetizing effect is therefore due to the coils *c c* alone, and, referring to Fig. 5*a* it will be observed that the poles *N S* are shifted one-half of the circumference of the ring During the next half revolution the operations are repeated, as represented in the Figs 6 to 8*a*.

A reference to the diagrams will make it clear that during one revolution of the armature the poles of the ring are shifted once around its periphery, and each revolution producing like effects, a rapid whirling of the poles in harmony with the rotation of the armature is the result. If the connections of either one of the circuits in the ring are reversed, the shifting of the poles is made to progress in the opposite direction, but the operation is identically the same. Instead of using four wires, with like result, three wires may be used, one forming a common return for both circuits.

This rotation or whirling of the poles manifests itself in a series of curious phenomena. If a delicately pivoted disk of steel or other magnetic metal is approached to the ring it is set in rapid rotation, the direction of rotation varying

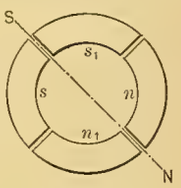


Fig. 4.

Fig. 4 a.

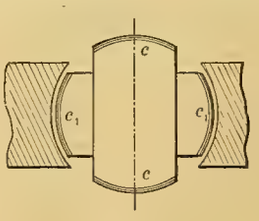


Fig. 5.

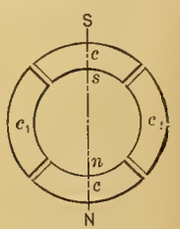


Fig. 5 a.

with the position of the disk. For instance, noting the direction outside of the ring it will be found that inside the ring it turns in an opposite direction, while it is unaffected if placed in a position symmetrical to the ring. This is easily explained. Each time that a pole approaches it induces an opposite pole in the nearest point on the disk and an attraction is produced upon that point; owing to this, as the pole is shifted further away from the disk a tangential pull is exerted upon the same, and the action being constantly repeated, a more or less rapid rotation of the disk is the result. As the pull is exerted mainly upon that part which is nearest to the ring, the rotation outside and inside, or right and left respectively, is in opposite directions. When placed symmetrically to the ring, the pull on opposite sides of the disk being equal, no rotation results. The action is based on the magnetic inertia of the iron; for this reason a disk of hard steel is much more affected than a disk of soft iron, the latter being capable of very rapid variations of magnetism. Such a disk has proven to be a very useful instrument in all these investigations, as it has enabled me to detect any irregularity in the action. A curious effect is also produced upon iron filings. By placing some upon a paper and holding them externally quite close to the ring they are set in a vibrating motion, remaining in the same place, although the paper may be moved back and forth; but in lifting the paper to a certain height which seems to be dependent on the intensity of the poles and the speed of rotation, they are thrown away in a direction always opposite to the supposed movement of the poles. If a paper with filings is put flat upon the ring and

1 Read before the American Institute of Electrical Engineers, May 16th.

the current turned on suddenly, the existence of a magnetic whirl may be easily observed.

To demonstrate the complete analogy between the ring and a revolving magnet, a strongly energized electro magnet was rotated by mechanical power, and phenomena identical in every particular to those mentioned above were observed.

Obviously, the rotation of the poles produces corresponding inductive effects and may be utilized to generate currents in a closed conductor placed within the influence of the poles. For this purpose it is convenient to wind a ring with two sets of superimposed coils forming respectively the primary and secondary circuits. In order to secure the most economical results the magnetic circuit should be completely closed as shown in Fig. 10, and with this object in view the construction may be modified at will.

The inductive effect exerted upon the secondary coils will be mainly due to the shifting or movement of the magnetic action ; but there may also be currents set up in the circuits in consequence of the variations in the intensity of the poles. However, by properly designing the generator and determining the magnetizing effect of the primary coils, the latter element may be made to disappear. The intensity of the poles being maintained constant, the action of the apparatus will be perfect and the same result will be secured as though the shifting were effected by means of a commutator with an infinite number of bars. In such case the theoretical relation between the energizing effect of each set of primary coils and their resultant magnetizing effect may be expressed by the equation of a circle having its center coinciding with that of an orthogonal system of axes, and in which the radius represents the resultant and the co-ordinates both of its components. These are then respectively the sine and cosine of the angle a between the radius and one of the axes ($O\,X$). Referring to Fig. 11 we have $r^2 = x^2 + y^2$; where $x = r \cos a$, and $y = r \sin a$.

Assuming the magnetizing effect of each set of coils in the transformer to be proportional to the current—which may be admitted for weak degrees of magnetization—then $x = K c$ and $y = K c^1$, where K is a constant and c and c^1 the current in both sets of coils respectively. Supposing further, the field of the generator to be uniform, we have for constant speed $c^1 = K^{-1} \sin a$ and $c = K^{-1} \sin (90^\circ + a) = K^{-1} \cos a$, where K^{-1} is a constant. See Fig. 12.

Therefore
$$x = K c = K K^{-1} \cos a ;$$
$$y = K c^1 = K K^{-1} \sin a, \text{ and}$$
$$K K^{-1} = r.$$

That is, for a uniform field the disposition of the two coils at right angles will secure the theoretical result, and the intensity of the shifting poles will be constant. But from $r^2 = x^2 + y^2$ it follows that for $y = 0$, $r = x$; it follows that the joint magnetizing effect of both sets of coils should be equal to the effect of one set when at its maximum action. In transformers and in a certain class of motors the fluctuation of the poles is not of great importance, but in another class of these motors it is desirable to obtain the theoretical result.

In applying this principle to the construction of motors, two typical forms of motor have been developed. First, a form having a comparatively small rotary effort at the start, but maintaining a perfectly uniform speed at all loads, which motor has been termed synchronous ; second a form possessing a great rotary effort at the start, the speed being dependent on the load.

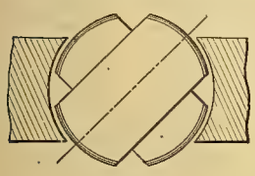
These motors may be operated in three different ways : 1. By the alternate currents of the source only. 2. By a combined action of these and of induced currents. 3. By the joint action of alternate and continuous currents.

The simplest form of a synchronous motor is obtained by winding a laminated ring provided with pole projections with four coils, and connecting the same in the manner before indicated. An iron disk having a segment cut away on each side may be used as an armature. Such a motor is shown in Fig. 9. The disk being arranged to rotate freely within the ring in close proximity to the projections, it is evident that as the poles are shifted it will, owing to its tendency to place itself in such a position as to embrace the greatest number of the lines of force, closely follow the movement of the poles, and its motion will be synchronous with that of the armature of the generator; that is, in the peculiar disposition shown in Fig. 9, in which the armature produces by one revolution two current impulses in each of the circuits. It is evident that if, by one revolution of the armature, a greater number of impulses is produced, the speed of the motor will be correspondingly increased Considering that the attraction exerted upon the disk is greatest when the same is in close proximity to the poles, it follows that such a motor will maintain exactly the same speed at all loads within the limits of its capacity.

To facilitate the starting the disk may be provided with a coil closed upon itself. The advantage secured by such a coil is evident. On the start the currents set up in the coil strongly energize the disk and increase the attraction exerted upon the same by the ring, and currents are generated in the coil as long as the speed of the armature is inferior to that of the poles. Considerable work may be performed by such a motor even if the speed be below normal. The intensity of the poles being constant, no currents will be generated in the coil when the motor is turning at its normal speed.

Instead of closing the coil upon itself, its ends may be connected by two insulated sliding rings, and a continuous current supplied to these from a suitable generator. The proper way to start such a motor is to close the coil upon itself until the normal speed is reached, or nearly so, and then turn on the continuous current. If the disk be very strongly energized by a continuous current the motor may not be able to start, but if it be weakly energized, or generally so that the magnetizing effect of the ring is preponderating it will start and reach the normal speed. Such a motor will maintain absolutely the same speed at all loads. It has also been found that if the motive power of the generator is not excessive, by checking the motor the speed of the generator is diminished in synchronism with that of the motor. It is characteristic of this form of motor that it cannot be reversed by reversing the continuous current through the coil.

(To be Continued.)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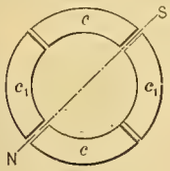
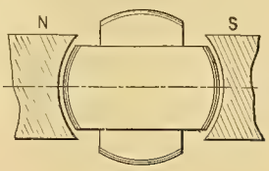


Fig. 6 a.



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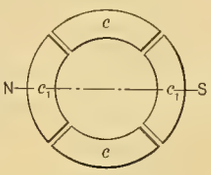

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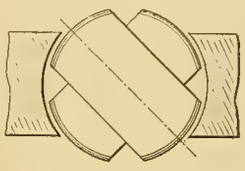
Fig. 8.

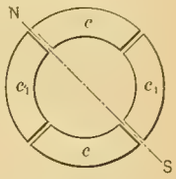

Fig. 8 a.

Long Distance Telegraphy.

The recently announced claim of a telegraphic circuit of over ten thousand miles, surpassing all previous experiments, is somewhat misleading. Many efforts at long circuit work have occurred during the past few years, the distance varying from 4,600 to 8,100 miles.

It is a matter of considerable pride to the old operators of the Western Union Telegraph company in San Francisco that the feat of transmitting clock signals through 7,200 miles of line and talking directly through that same line has never been equalled. The occasion of this feat was the telegraphic determination of the difference of longitude in time between the United States Coast Survey Station in San Francisco and the observatory of the Harvard University at Cambridge in the year 1869. In order to determine the time of transmission of a signal either from the clock (or from the operator's key) over the given length of the line of 3,600 miles, three different methods were devised. One of these was was original with Prof. George Davidson, who had charge of the observations. Through the liberality of the management of the Western Union Telegraph company, a double circuit of line was looped at Cambridge, so that there extended from the San Francisco Observatory 3,600 miles to Cambridge, and the return from Cambridge by a somewhat different route of nearly equal length. The two "earths" were under the San Francisco Observatory, distant from each other not more than ten feet The line was first opened by an operator in the observatory and when the last connection was made at Cambridge the San Francisco operator was considerably astonished to get his own message back within one second of time.

Then the astronomical break-circuit clock was thrown into line and made its first break on a pen recording upon a revolving cylinder of paper in the San Francisco Observatory, and after this break had traversed the line to Cambridge it returned and made a break upon a second pen moving parallel with the former in about eight-tenths of a second of time. This was continued every second for several minutes, and was repeated upon several nights, and when one of the twelve batteries in this long circuit was removed the wave length time was reduced to only sixty-five hundredths of a second. Conversation was, of course, carried on at the same rate of speed. This feat over a line 7,200 miles in length has been unrivalled up to the present time, both as a practical working exhibit and a scientific success. —*San Francisco Alta.*

Pumping in Mines by Motors.

The following description of a motor plant to be installed at St. John's colliery is given by the London *Electrical Review :* It is designed to cope with a salt water feed of 5,100 gallons per hour, at a vertical depth of nearly 900 feet below the surface. It was decided to raise the water at one lift, and at the rate of 7,200 gallons per hour, so that the pumps need only work eighteen hours out of the twenty-four in order to cope with the full quantity of water. The plant consists of a 30 normal horse power compound semi-fixed engine, by Messrs. Robey & Co., driving an Immisch dynamo of 53 horse power. The armature of this machine is 16 inches diameter by 24 inches long, and the average current is 66 amperes at 600 volts pressure ; but owing to the variation of load in the high pressure pumps, the current varies about 10 amperes up and down from the average. The weight of the dynamo is about four tons. The motor, which weighs three and one-half tons, is also of the Immisch type, and of 575 volts. The speed of both dynamo and motor is 450 revolutions per minute. The actual horse power in water lifted at 120 gallons per minute is 33 horse power. Thus, the efficiency from the electrical energy supplied by the dynamo to the water actually lifted is 62 per cent., which includes the loss of energy in the circuit, motor, gearing, pumps and that caused by friction in the rising main.

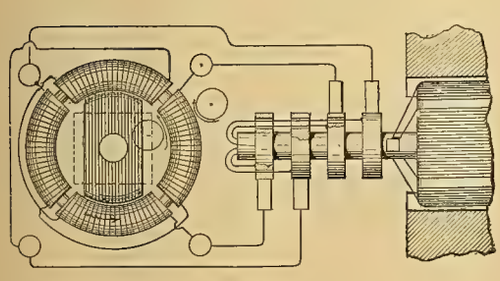
Fig. 9.

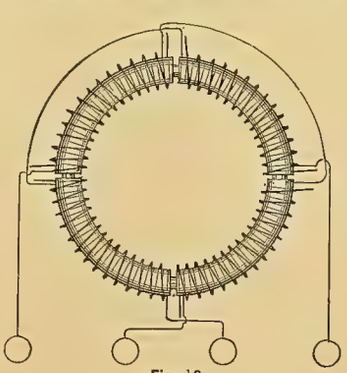
Fig. 10.

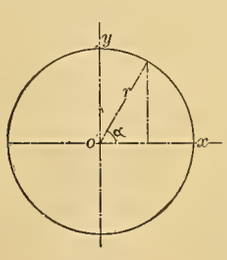

Fig. 11.

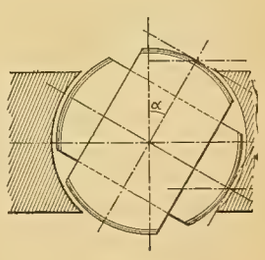

Fig. 12.

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Notice to Subscribers.

Subscriptions to the WESTERN ELECTRICIAN, weekly, at $3 per annum and *The Electrical Engineer*, of New York, monthly, at $3 per annum now filled from this office at $5 per annum for both journals.

THE discussion of Mr. Sperry's paper on "Motors and alternating currents," read before the club at its last meeting, is given in another place. Several points in the paper are elucidated by the remarks of Messrs. Leonard, Cutter and Sperry.

MR. WRIGHT'S device for protecting the armatures of dynamos from the evil results of a short circuit is very simple and promises to be effective. In the great electrical field busy inventors find numberless opportunities to exercise their ingenuity.

UNFORTUNATELY, electricity is not always employed to serve a good purpose. A gambling den raided by the police in New York city, last week, was provided with a door bell which, when rung in the ordinary way, caused a series of bells in all parts of the house to commence ringing. The police, however, did not use the bell, but reached an upper window by means of a 45-foot ladder.

ON commenting on electric executions, the Waterbury *Sunday Herald* says, sarcastically, that convicted murderers might be turned loose in New York city, and that the chances for their execution by a detached wire would be excellent.

HERE is a chance for electric light companies. An Albany inventor proposes to lay a pneumatic tube across the ocean, by means of which passengers can be sent abroad in four or five hours. The entire tube will be lighted by electricity.

THE report has received a wide circulation that Queen Victoria for some unaccountable reason disliked the electric light. That the rumor was incorrect is proved by the fact that her majesty traveled to Scotland last week in a coach lighted brilliantly by incandescent light. The queen would not have hesitated about calling for less serviceable light, had she desired it.

IT has been decided to light buoys in Gedney's channel, in New York harbor, by electric light. The practicability of this means of rendering navigation in a harbor safer at night has been demonstrated. A buoy off Robbins' reef light house, in the upper bay, was of great service to the Staten Island ferry boat pilots all last winter. No difficulty was experienced in maintaining the light, even when the bay was full of ice.

OUR St. Louis correspondence contains an account of an interesting suit which has just been instituted by the corporation counsel, to test the validity of a municipal ordinance reducing telephone charges from $100 to $50. The telephone company claims that city officials have no authority to interfere with rates. The case is an interesting one and will attract no little attention.

THOSE who are interested in official destruction of life by the electric current will soon have an opportunity to witness interesting experiments in this direction. The society for the prevention of cruelty to animals in New York city proposes to build a hospital for domestic animals. One department of the building will be devoted to putting to death animals whose cases are hopeless. President Bergh has received a letter from Mr. Edison, in which the latter speaks of the plan as an eminently practical one.

THE New York common council has refused to grant a franchise permitting the street car company to operate the Fourth avenue road by electric motors. One paper in the metropolis bluntly asks the alderman how much they want in the way of bribes. The company, it is said, will be able to employ the electric system on a portion of the line in spite of the aldermen. If this be the case public opinion will soon cause the council to grant the privilege now withheld. New York is an interesting city.

THE discussion of the general subject "the continuous *vs.* the alternating current" will be continued at the meeting of the Chicago Electric club next Monday evening. Geo. H. Bliss will appear in behalf of the continuous current, and the title he has chosen for his paper will be the same as that quoted above. Mr. Bliss's former connection with the Edison company and his subsequent study and observation have made him an advocate of the continuous current and consequently an able argument for that current may be anticipated.

IT is stated that street car employes in Indianapolis have petitioned the officers of the company to remove a car now running on the stock yards line, because its history has proved it an unlucky vehicle. A man has been murdered on it, mechanics who have attempted to repair it have been injured, conductors have been robbed on it, and a score of other misfortunes are connected with its history. An electric motor attached to the car would doubtless bring it good luck, and all the conductors who were in charge of it would grow rich.

THE London *Lancet* sees a possibility of a danger if the practice of electrical executions were generally adopted. The electric current might simply cause a cataleptic condition such as not infrequently happens in the case of a lightning stroke. In such an event the authorities thinking naturally enough that the criminal was dead, might turn the body over to friends and resuscitation might be effected. It is urged also that the danger of burying a criminal alive might exist, for the same reason. Competent physicians are usually in attendance at executions, and they ought to be able to ascertain readily if the penalty of the law had been paid.

ANOTHER chapter on "Practical telephony" is given this week and is one of the most interesting that has been published. Mr. Lockwood takes occasion to make clear a point about batteries that has confused many a young worker in electricity—the difference between a positive plate in a battery and the positive pole. The zinc in a zinc and carbon or copper battery within the liquid of the battery, is the *positive plate*, while outside the liquid or the screw terminal attached thereto, is the *negative pole*: the converse holds true for the copper carbon or manganese peroxide element. We have taken occasion heretofore to refer of the eminently practical and easy manner in which Mr. Lockwood treats the subject in hand, and the point referred to above is a fine illustration of the author's clear way of imparting information. While the point made is one that probably is familiar to electricians, we believe many of the young workers will thank Mr. Lockwood for clearing up what seems a conflict in terms.

THE speed contest between the long distance telephone and the telegraph in New York last week was an experiment of an interesting character. According to the conditions of the test, a dispatch was to be transmitted to Boston in shape for the printers. In accordance with the recognized etiquette of contests, the experts who were to operate the rival instruments shook hands and took their positions. At the word from a reporter the experiment commenced. Time was called in ten minutes. In that time the telephone operator had spoken 346 words and the telegraph expert had sent 330 words exclusive of punctuation marks. The telephone operator was obliged to stop to spell out three words. A message was received three minutes later by wire stating that the telegraph copy was in shape for the printers, but that the telephone message was incomprehensible as abbreviations had been employed. Tests of this kind are interesting, and it is gratifying to know that the contest will be repeated. A type-writer will be used by the telephone receiver in the next experiment. It was a victory for the telegraph; but the telephone can submit to the defeat with good grace. It has been wearing laurels since it accomplished such important service during the blizzard, when the telegraph system was demoralized. By all means let the contest be repeated.

ON other pages will be found the first part of a paper by Nikola Tesla, describing a new system of alternate current motors and transformers, read before the American Institute of Electrical Engineers, in annual meeting, May 16th. The delay incident to the preparation of an unusual number of cuts forbade the insertion of the paper in the report of the proceedings of the institute published last week.

Mr. Tesla, in his introduction, expresses much confidence in his system of electrical distribution and transmission of power by means of alternate currents, "affording peculiar advantages"—to quote direct—"particularly in the way of motors, which I am confident will at once establish the superior adaptability of these currents to the transmission of power, and will show that many results heretofore unattainable can be reached by their use—results which are very much desired in the practical operation of such systems, and which cannot be accomplished by means of continuous currents."

This paper is bound to attract much attention. The advocates of the continuous current, during the discussion of the papers presented before the Chicago Electric club, have made much of the argument that motors could not be run successfully by alternating currents; on the other hand, the advocates of the alternating current have maintained that they could, and have demonstrated theoretically that they could. Now Mr. Tesla advances a novel system, which has not hitherto been described, and also demonstrates the accuracy of his theories.

Without entering at this time upon a comment on the paper in question, we commend the part published to careful perusal and study.

Practical Telephony.

PART X.

By Thos. D. Lockwood.

It will sometimes be found that a Leclanché cell will totally lose its power, when apparently, it is in good order. When this happens, it is usually due to the formation of white lead between the leaden cap and the top of the carbon plate. Cells made in a first-class manner will not often act in this way. It does no harm, however, in any case, to cautiously bore a hole through the leaden cap and carbon, and then to pass a copper bolt, or rivet through it, screwing or riveting it tight down on both sides. Occasionally, also, the full strength of the battery fails to develope, by reason of the accidental stopping of the air holes through the sealing mixture. In such cases the remedy is to thrust a small screw-driver through the holes; if this indeed be the cause of the trouble, a gush of gas will be observed to issue from the holes, as soon as they are cleared Be sure in the application of this remedy to use a screw-driver or punch sufficiently small, so as not to burst the cells.

A few words about prism batteries, so-called, may not be out of place. The prism Leclanché cell, as most of us know, resembles the other in that it has a glass containing cap, a positive plate in the form of a zinc rod or pencil, and a carbon nucleus for the negative plate; it differs from it in that the peroxide of manganese and crushed carbon which surround the said nucleus instead of being closely packed around it, in a porous cup, are mixed together, with some suitable cement, and then conglomerated under heavy pressure into the form of bricks. Two of these bricks are provided for each cell and one is mounted on each side of the carbon plate, the whole being held together by elastic bands. These batteries utilizing the prism form of depolarizer have found a good deal of favor in some circles. I do not however think, that upon the whole they are anything like as good as a first-class disque cell; I think they have a tendency to polarize quicker, and that while their normal internal resistance may be a little lower than those of the porous cup form, it soon rises.

There is also a disposition on the part of many users to work all the cells, after their usefulness is impaired, and my experience has led me to the belief that this disposition is greater where the prism form is concerned, than it is with the other. It is not easy for me to say why I think this so; but I suppose it is because in the prism form there is nothing concealed. All the parts are open to the eye, and the impression received by one who has not had much experience is, that the elements look about the same as they did at first, hence that they are the same, and he proceeds to re-charge the cell with fresh sal-ammoniac; whereas the fact is, that although the appearance of the prisms is unchanged, the peroxide of manganese is reduced to a sesqui-oxide; an oxide of a lower grade, with no oxygen to spare for the neutralization of free hydrogen.

With the disque cell on the other hand, much is concealed; and when this form wears out, the user or the person in charge is much more likely to believe that the trouble is where he cannot see it, and will therefore do at once what he ought to do; i. e., discard the used-up porous cup, and put in another.

Before leaving this subject, I rather think that I ought to briefly advert to a general point which may otherwise be productive of confusion in the minds of those who have not heretofore had occasion to study the subject, or to find the matter explained elsewhere. If the reader will take the trouble to look back, he will see that I called the zinc the *positive* plate. "But," says some one, "the zinc is the *negative* pole; carbon or copper is in the battery the positive pole." Right you are, my friend, but so am I. Suppose we had a battery before us, having elements of zinc and carbon, the zinc plate is the *positive plate* as I called it, but at the same time is the *negative pole* as you called it. Consequently the carbon plate must also be the *negative plate*, and also the *positive pole*. How shall we explain this apparent contradiction in terms? The current is assumed to originate in consequence of the chemical action of the solutions upon the zinc plate, and therefore it is also assumed to start from the surface of the zinc plate within the liquid. Whenever any two metals are placed in a liquid which oxidizes one of them more powerfully or more easily than it does the other, that which is the most easily acted upon is said to be electro-positive to the other in that specific liquid. Thus in a solution of sulphuric acid in water, zinc is said to be electro-positive to copper or carbon, because the solution will attack it in preference to the copper or carbon; and in like manner in a solution of sal-ammoniac, zinc is electro-positive to peroxide of manganese. Thus the positive plate in any battery is that which is attacked by the exciting solution, for there the electric current, or what we call the electric current originates. But the electric current once generated, passes through the liquid to the opposite plate, in the present case, the carbon plate this is called the negative plate, first, because the current does not start from it, and secondly because the zinc is called the positive. Coming now to poles, we find that as the current starts from the surface of the zinc plate within the liquid, and passes through the liquid to the carbon plate, it must of necessity issue from the battery at the latter; and because the current here issues or is supposed to issue from the battery, the end of the carbon plate which projects from the liquid, and to which is attached the binding screw, or the wire connection for the external circuit is called the positive pole. The end of the zinc plate projecting from the liquid is connected with the other end of the circuit, either directly or through the earth; here, therefore the current returns to the battery, and consequently this is called the negative pole. The fact is therefore that the zinc within the liquid is the positive plate. The zinc outside the liquid, or the screw terminal attached thereto

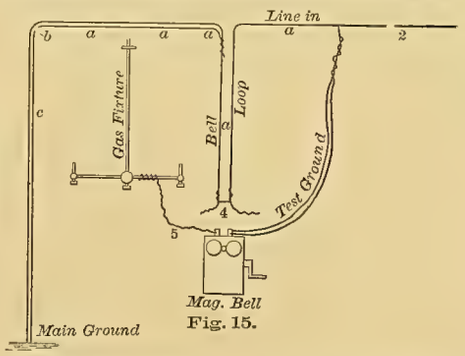

Fig. 15.

is the negative pole. The copper, carbon or manganese peroxide plate within the liquid is the negative plate. But that part of the negative plate that is outside of the liquid, and to which the circuit wire is attachable is the positive pole.

I have now finished the description of a subscriber's station apparatus, in a rambling way, I fear, and with a good many excursions to one side or the other. It has taken more words than I supposed it would, but I think I have at least made the matter plain.

We will now attempt the consideration of the ailments which may beset the apparatus as a whole. As already indicated, the first duty of a repairer, be he inspector or lineman, is to find out whether the trouble is located in the central station, on the intermediate circuit, or at the subscribers' stations. We are at present considering the subscriber's station, and may assume that the trouble, whatever it is, has been so far located, that the repairer knows it is somewhere there, but what the trouble is, he does not so far know. Let him then study the symptoms, and make as the doctors say, a diagnosis.

First: Is it the signaling part of the apparatus, or the speaking and hearing part, which fails to work properly?

Secondly: If the trouble lies in the signaling apparatus, which part is in fault, the signal sending or the signal receiving appliances; and if the conversation apparatus is defective, is the defect in the transmitting or in the receiving appliances?

After the repairer has decided these matters for himself, he has in fact accomplished the major part of the work. For it is evident that certain portions of the telephone circuit, are common to all of the operations of all the apparatus, while certain other portions are only brought into use during specific operations. If, for example, it be found that from a certain sub-station it is impossible to send a call; that the said station cannot receive a call, and that no conversation with the said station can be carried on, and if as already supposed, the trouble is known to be within the sub-station, we may be assured of one thing; the trouble being one which affects all of the functions of the instrument must, of necessity, be located upon, or at some portion of the circuit which is used both during calling in either direction or in conversation, and therefore in some part of the apparatus which is always in circuit. This is evidently a broken wire; if it were a short circuit, the generator would at least ring its own bell. The break must certainly be either somewhere in the bell box; on that part of the circuit between the bell box and the entering point, or on that part between the bell box and the ground terminal. A good deal of the value of our inspector consists in his ability to intuitively jump to the correct conclusion; to bring common sense and inexorable logic, to the aid of education and experience in such matters. A repairer who combines these virtues at once reflects that the inside of the box is the least likely place for a break, because it has no great number of moving parts, and is kept locked up; and that the ground end is the most likely place for the trouble because the ground connection is exposed to alteration from gas men, is often awkwardly made, and is easily exposed to manifold injury. But it is easy to find out whether the bell box is all right or not. Connect the two main posts by a short piece of wire, and ring. If it will ring, the box is all right. If it will not ring, the trouble is in the box. In the latter case open the box and examine it. Most likely you will at once see the broken place. The break cannot be in the generator armature coils, because these are cut out when the bell is at rest, and yet the circuit is then open. Nor clearly can it be in the bell coils, as these are switched out, when the telephone is in use, and still the circuit is open. It must therefore of necessity be either in the connecting wires, or the hinges, or in the switch. This should be a sufficient guide for a hunter of fair intelligence.

But suppose you find that the bell when its binding posts are connected, does ring; this proves the bell to be all right; you next examine the ground end carefully, and the break will probably be found by the aid of a little pulling. A broken wire near a ground terminal should always be made the excuse for an entirely new ground wire. If a close search fail to expose the fault the only thing to be done is to test for it.

Open the circuit at the place where the line enters, by cutting or disconnecting the wire, or better still by having the central office open the wire there; disconnect the two wires of the bell loop from the binding screws, and unite them by a short piece of wire 4, Fig. 15. Run a wire 5, from the gas fixture or any other convenient ground to one of the bell binding screws, and attach a long free testing wire to the other; bare the end of the latter. Work the crank of the bell box, and touch the free end of the testing wire to different points *a* in the length of the telephone wire, commencing near the entering point, and gradually proceeding inward. The telephone wire is, of course, covered; some means must therefore be adopted to reach the metal. A good way is to wind the bared end of the testing wire round a darning needle, or the blade of a pen knife, and to prick the wire at various places. At first, the bell will not ring, because the circuit in which the bell is included is open, the test wire being touched at a point between the fault, and the place opened for test. Suppose the fault is at the point *b*, where the wire is perhaps broken within the covering, as long as the main wire is touched at any of the points *a* the bell will not ring because its circuit will not be closed, but if at length the test wire touch it at a point *c* on the other side of *b*, the bell will ring, and the fault is located between this point *c* and the last point *a* where the bell failed to ring. A concealed break like this will probably be found at some weak spot beneath the wire covering or under a staple.

(To be continued.)

Chicago Electric Club.[1]

C. C. Haskins presided at the meeting in the absence of the president. Routine business was dispensed with and the club proceeded at once to listen to the reading of Mr. Sperry's paper. At the close of the paper, on motion of Mr. Clark, a vote of thanks was passed and discussion of the paper was called for.

THE CHAIRMAN: Remarks are in order. Mr. Leonard, we would like to hear from you.

MR. LEONARD: I think Mr. Sperry has certainly given us a very clear idea of the great possibilities to be obtained by alternating current motors if perfected. But I was struck, as he was speaking of the application to street railways, etc., by the thought which has been frequently advanced in the discussion upon this topic, that there is in the alternating motor a great lack of the most desirable features of the motor for a street car, that is, the great torque effort when the car is at rest. The load on the alternating motor has to be applied rather gradually, and the greatest torque is obtained when the motor is running at its full speed, and on that account the running of the street car would seem to be a very serious matter at the present time, that being a serious obstacle in the way of doing it.

There is one point I think must be borne in mind, in regard to alternating current motors; that is, the energy is positive or negative, in accordance with whether the sign of the electro motive force and current is similar or dissimilar; yet the heating effect is entirely independent of the sign, and therefore the heating effect of the alternating current motor for a certain amount of horse-power output, is a great many times as much as that of the continuous current; in other words, to accomplish this, to get the motor to a certain horse-power, it would have to be built very much larger, in order to provide for the great heating effect.

Another point in alternating current motors has to be carefully figured out by somebody. There is a certain maximum of economy, and that point is attained in such a way that if the load be increased slightly, the difference between the energies of different signs decreases rapidly, and the motor would be apt to slow down, and, not receiving enough energy to keep the motion up, to stop; therefore, it becomes necessary that the motor be operated under a pretty tolerably constant load. If the load be tolerably constant the motor must be operated at a point very much below its maximum economy in order that it may have sufficient reserve to take care of sudden loads, which otherwise would stop it.

There is no question of the fact, if all these obstacles in the way of the torque and oscillation in receiving and giving back the energy to the circuit, in alternating motors, could be overcome—but which appear to be almost inherent in them—there is a tremendous field for them, and no doubt in any event there will be a field in alternating current motors to a limited extent in small sizes.

As to street car motors, if we could place in these same manholes Mr. Sperry talks of, the continuous current transformer which requires such slight attention as to be self-operating, we could still have the advantage of small independent circuits for the transmission of a large amount of energy, of high electro motive force, and the utilization of the same by the low tension currents, and we would have the great advantage of greater torque in starting a street car, and also the effect of less chance of a break-down, inasmuch as there would be more likelihood of the motors being operated in multiple arc. In the arrangement Mr. Sperry indicated, each section receiving its supply from one primary circuit would in case of trouble to that one circuit render railway cars on that section entirely inoperative, and it would be rather difficult to get other cars following past such a dead portion of the track.

MR. CUTTER: I do not feel that I have very much to say upon this question. I hope that the continuous current converter will be made which requires attention but once a week. I have not seen it yet, so I have not much of an idea what it is or about how it is to be accomplished. The motor for an alternating current is also a difficult problem. I have seen many forms of continuous current converters, although at the time I saw them they were not labeled that way; we call them inductoriums, motor generators, etc. I must confess I fail to realize why the last speaker places so much confidence in them. The alternating current motor may be very difficult to manufacture for street railways, but much less so for other uses of power, and this will be the great opportunity for power for this class of work, there being so many installations where electric energy can be rented for lighting by night, and for power by day to good profit—where this energy can be distributed at great distance and at small cost, and which also has the desirable object of flexibility, so to speak, in laying out circuits.

I am called upon frequently for estimates of the cost of distributing the energy, either of water power or of large industrial establishments, to the center of a town where mere rental of electric lights would hardly pay, but where if motors could also be rented, the revenue would be entirely satisfactory, and many of these cases are necessarily abandoned when considered with continuous currents because of the heavy expense. Now, if we had a good alternating current motor the problem would be very simple, indeed, of distributing our energy, and the cost of doing so would generally be quite small.

MR. LEONARD: I beg to call the last speaker's attention now to the fact that the cost of conductors is not dependent upon whether the current is alternating or continuous, but upon the loss in volts and the initial electro-motive force in use. I cannot see the application of his remark that the cost of transmitting the energy of a continous current to the center of a town would make it more expensive than to do so with the alternating current, or that the alternating current could be used cheaper.

MR. CUTTER: I made that remark backed up by what I said previously, that I had no faith in the continuous current converter for this work, and there are certainly serious difficulties in the use of such a converter, one of the principal difficulties being that they require a good deal of attention. It is a machine, as Mr. Leonard himself said, a machine of high velocity, and that means attention; therefore, the method of distribution of these continuous converters is by secondary stations, and from these stations the distribution of low potential circuits; that means high percentage of loss in the secondary circuits. It also means the necessary regulators in all of these secondary circuits—all of these points are covered in my paper, and all of which I still feel to be forcible objections to this method of distribution.

MR. LEONARD: I think Mr. Cutter has not seen the point I am driving at yet. He started in by saying he was often called upon to make estimates for the distribution of power over long distances to the center of a town, for town distribution or for manufacturing industries. We are also often called upon and have submitted estimates for that purpose, and we use a continuous current of high electromotive force and a motor utilizing such current direct.

MR. CUTTER: I see that Mr. Leonard now confines himself to the rental of power; my remarks covered rental of power and rental of light. I also feel that rental of power with a continuous current of high potential would be very limited, because of the difficulty, even impossibility, of making small motors work upon high potential circuits. It is by the rental of small motors that we would realize the most revenue.

MR. LEONARD: We have one method by which we can give both power and light on low potential circuits, and still accomplish that economy upon the conductors in transmitting the power. I would like to have Mr. Cutter point out a similar method by the alternating current. We can transmit our power, and we can operate a motor at the other end of the line; we can then from that motor operate dynamos, which will give us a 3-wire distribution from the heart of the town for any purpose of light or power. As Mr Cutter thinks the motor generator is liable to get out of order, we will confine ourselves to such well known factors as an ordinary motor and dynamo.

MR. CUTTER: The remarks I would make would be self-evident, that is, we will use our alternating motor in the same manner, if found advisable to do so, there being one advantage in that method over the rather far-fetched use of the continuous current in this: We will suppose that the objection to alternating current motors which Mr. Leonard mentions exists, that they are not powerful enough at starting. Very well. Then we will put in a large motor to keep it running all the time, or at least all the time that we are in need of power, and from the same circuits we will run a few small wires around town; put up a converter properly here and there without the difficulties of the low potential system; and our alternating current will give us any phase we want, is easily handled, and also we can use the motor for power if wanted.

MR. LEONARD: I wish to say, Mr. Chairman, that quite recently we had a case where first-class water power was located about four miles from the heart of the town of about 8,000 people, in a busy town and growing rapidly. We have submitted estimates and guaranteed the results of operating from the water power. About three miles off in one direction, at right angles to the direction of the town, is a brick yard, which would require about thirty-five horse power. The circuit down toward the town was to operate one thousand 16 candle power lamps, and supply power of 150 horse power, fifty horse power to operate small industries, and the balance in two large motors for manufacturing industries. I think that is pretty nearly a parallel case to the one that Mr. Cutter has quoted. And I should like to know what method he has in his alternating current to submit and whether he can guarantee the result from the same, that it will do the same kind of work.

MR. CUTTER: The remarks of Mr. Leonard pleased me very much. I find they are striving for a conversion of their electric energy, and the continuous current converter is a converter, and those people who are crying against the alternating current are willing to admit that. The question is the relative merits of the continuous current converter and the alternative. The continuous converter has a revolving armature, or is a machine to alternate the continuous current. Instead of making that machine with all its inherent difficulties—almost floating in oil—I think it is best to make the alternating current by the dynamo in the generating station and then convert it to whatever we want. Mr. Leonard has asked me a direct question, and I simply say that I have not recommended an alternating motor converter for the job. I think I have figured on the same thing. But I want to recommend the alternating motor current, and I expect to do it in a very short time; I speak advisedly, because I have seen these motors in operation, various types of them, and working quite successfully. Like the continuous current converter, it is not yet ready for the market.

MR. LEONARD: I would like to ask Mr. Cutter if he is ready to guarantee to do the work by the alternating current in this case, because the remark he has made is scarcely just, inasmuch as I have stated that we made estimates upon the work and guaranteed the results.

MR. SPERRY: I think perhaps it might be explained that these motors which stop suddenly when overloaded and which require extraneous means in starting are the ones which I did not mention at length in my paper. These motors are alternating current machines reversed, or some variation of them; they are compelled to synchronize and if they lose a part of the phase length by overload will lose their torque and therefore stop. The series motor is not open to these objections, as the synchronism has nothing to do with the operation. The motors are capable of overload and will behave the same as the direct current motor under like conditions. It meets every objection.

MR. LEONARD: I hardly agree with Mr. Sperry as to the fact that a series wound motor covers every objection; it strikes me there is a maximum amount of energy which that motor will give out, and that in the case of the continuous current motor, the motor would slow down simply and continue to run, while with the alternating current motor, which is overloaded in that way, the energy will immediately decrease and it would slow down, and by so doing would rapidly lose the actuating power; certainly there would not be the same torque there would be in the case of continuous current motor.

MR. SPERRY: Of course the size of the motor would have to be larger than the continuous current motor to do the same work. But I have investigated, so far as my limited time would allow, and I am perfectly convinced that the statements I made are true with regard to working the same as the continuous current motors, which is a matter of great importance, because if they are applied to street cars, or applied any place where varying power is demanded, the moment the machine or load is applied the inertia of that load that would have to be overcome would be nine or ten times as much for a short time as would be required to maintain the motion when once such motion is gained. This is true in case of almost any use to which these motors are put, and if the motor will stop under these conditions it is practically useless. I will report that the motor of ordinary construction with its cores finely divided is not open to this objection.

MR. LEONARD: I should like to ask Mr. Sperry the results if an alternating current motor, which was operating some piece of machinery, suddenly had its load increased very greatly, so that it slowed down. It strikes me that in this case the electrical impulse could not synchronize with the mechanical motion, and since the actuating power would be lacking, it would slow right down and stop, and not having the necessary torque, could not start again until the load was thrown off and gradually put on again.

MR. SPERRY: Mr. Leonard is mistaken in this. His remarks are perfectly relevant to the motor when it consists of a multipolar machine, or an alternating current machine reversed. This will stop under the conditions named, but the continuous current motor used and adopted to the alternating current will not stop.

Of course, if the overload is so serious as to cripple the motor, it will eventually stop, the same as any motor and engine will when the demand for power exceeds the amount furnished to the motor; but this is not the question. In the motor in question the torque will increase as the load increases, just as it should, and the fact as to whether the speed is a synchronous one or not has nothing to do with it. Furthermore, if this motor is made compound wound or with a high shunt, it will be self-regulating, the same with alternating currents as with direct; the proportions will have to be different to allow for the effects of retardation. The problem resolves itself to this, what will the motor do while the current is flowing, which forms one phase of the alternation?

MR. LEONARD: I would ask Mr. Sperry if such a motor as that has been constructed?

MR. SPERRY: I can say I think it has.

[1] Discussion of Elmer A. Sperry's paper, "Motors and Alternating Currents," read before the club May 21, 1888.

The Book Table.

PRINCIPLES OF DYNAMO ELECTRIC MACHINES. By Carl Hering; 279 pages, 7x4¾ inches, illustrated. Published by W. J. Johnston, New York.

The name of Carl Hering in connection with a book is a synonym for clearness, completeness, and accuracy of statement. The subject matter of the volume in question has appeared in serial form in the *Electrical Engineer*, but since its original publication has been thoroughly revised, and has been made more complete by the addition of appendices covering much valuable information. We have taken great pleasure in giving the book a careful perusal, and can most heartily commend it to engineers and machinists engaged in dynamo construction, and to students of electrical engineering.

A PRACTICAL METHOD OF CALCULATING AND DESIGNING DYNAMOS AND MOTORS. By Francis B. Crocker. A paper read before the New York Electrical society, March 28th. Pamphlet, 15 pp. Published by the society.

There is nothing pretentious in this little pamphlet. It is eminently plain, practical, and clear from commencement to end. The formulæ are exceedingly simple, and can be worked out by any boy with a common school education.

We have received, through the courtesy of Anthony Reckenzaun, a pamphlet issued by Stephens, Smith & Co., Millwall, London, England, entitled "Electricity as a motive power, with especial reference to its adaptability for marine propulsion."

The pamphlet is not designed as an elaborate and exhaustive treatise upon the electric motor, but is confined largely to a description of the memorable trip of the electric boat Volta from Dover to Calais and return, September 13, 1886, and the press comments of the day upon the feat. As a memoir of the day that marked a great achievement, which demonstrated beyond question the adaptability of the electric motor to marine propulsion, the pamphlet is valuable and will be preserved.

Electrical Scale.

The Electric Advertising Scale company has put on the market a scale which is attracting considerable attention on account of its novelty. In form it resembles the ordinary automatic scale, but it accomplishes its purpose in a more popular way. A person puts a nickel into a slot and steps upon the platform. The electrical mechanism is set in operation and a card with a certificate of the exact weight of the person drops out on a receiving board. The mechanism is simple, consisting in the main of a magnet and a small electric motor. The cards on which is printed the weight will be used for advertising purposes. The scale has been perfected and works to a charm. The company's officers are: President, H. Burkholder, Chicago; vice-president, Dr.

Carter, Waukegan; treasurer, R. W. Coon, Waukegan; secretary, H. S. Clark, Chicago.

Motors for Small Powers in Chicago.

In the issue of the WESTERN ELECTRICIAN of February 4th the fact was chronicled that the first small motor for power purposes run from an arc circuit of the Chicago Arc Light and Power company, was in operation in Chicago, and the opinion was expressed that the prospects for an extensive use of motors were very bright. Last week saw an order recorded for the twenty-eighth Baxter motor for use in this city. The Chicago office of the Baxter Electric Manufacturing and Motor company, W. W. Munro, manager, was opened for business ten weeks ago, and the motors ordered of them have all been ordered during that time.

In Chicago motors are used in blank book, clothing, cloak, dress trimming, electric appliance, exhaust fan, hat and cap, leather, truss, shirt, vest, and ventilator manufactories, book binderies, to run coffee mills, exhaust fans, lithographing and printing establishments, by publishers, lapidists and opticians.

In company with Frank L. Perry, electrician of the western department of this company, who installed all the motors in Chicago, a WESTERN ELECTRICIAN representative made a tour of investigation. The first motor seen was in the shop of Chas. Essig, a lapidist on State street, who was found busily grinding stones of all manner of description. Mr. Essig is in a building in which there is no power, and is located on the top floor. He is eminently well pleased with the operation of his half-horse power motor.

A printing establishment run by a two horse power motor was next visited. Several small presses and a paper cutter were in operation, and here, too, great satisfaction was expressed with the operation of the motor.

In the shop of the Western Leather Manufacturing company there was a one-horse power motor operating three sewing machines, a strap puncher, two wax thread machines, and a harness-creasing machine. The foreman and the girls, who had formerly run the machines by foot power, were equally loud in their expressions of delight—the foreman in that on certain classes of work at least two-thirds more was accomplished in a day's time than under the old method, and the girls in that they could accomplish so much more work at greater ease to themselves.

In each of the cases the automatic regulation of the motors was perfect.

In this connection a comparative schedule of charges for current for small motors in Chicago and several other cities will be of interest.

SCHEDULE OF CHARGES PER MONTH IN DOLLARS FOR CURRENT FOR SMALL MOTORS.

Horse Power	1/10	1/8	1/4	1/2	1	1½	2	3	4	5	6	7	8	9	10
Chicago, Ill.	$5	$5	$5	$6.50	$10		$20	$30	$38	$46	$53	$60	$67	$74	$80
Milwaukee		2.50	3	5	10		20		30		45				65
Cleveland					8		15	21	26 50	32	37.50				
New York				6	10	15	20	25		40			55		65
Baltimore		2.50	3	5	10		20		30		45				65
Grand Rapids		2		6	10		16.66		29.11		41.11				
St. Louis			4.35	7.60	10.85		21.70	29.90	39 85	47.65		63.70			86.65

The Electric Waiter.

Nature describes in a recent issue the installation of an electrical waiter system in the mansion of Gaston Menier, which is supplementary to that gentleman's electric light installation. Having accumulators available, Mr. Menier causes his dinner to be served without any servant entering the dining-room. A miniature railway train passing and stopping before every guest accomplishes rapidly and safely, under the guidance of the host, all the functions of a punctual and well-conducted service. This train, which runs from the kitchen to the table and thence back to the kitchen in order to fetch dishes, return them, bring plates, etc., consists of two essential parts —the railway track and the vehicle. The track is composed of four parallel rails, on the two outside ones of which the wheels of the train are running. They are isolated from each other, and communicate with the inductor of a dynamo electric motor. The two inside rails on which small contact rollers are running, place the electrical source—a battery of twenty accumulators—in communication with the inductor of a motor by means of a commutator fixed at the right of the host, who is thus enabled to stop the train or to reverse it by a simple change of the current. The oak board on which the four rails is fixed rests on supports placed at regular intervals, and which raise the little track about ten centimetres above the level of the table cloth. The space underneath is utilized for placing the table requisites, such as table napkins and salt cellars on the table The track leads from the kitchen or pantry, where the dishes are placed in the train through a little tunnel, and then arrives in the dining-room. The train strikes a first switch where the track divides into two parts which pass respectively at the right and left before each row of guests. At the extreme opposite end the two tracks unite again, so as to form a circular railway. The width of the track is 115 millimetres, which suffices to give the "rolling stock" the necessary stability. The train or carriage consists of a platform 75 centimetres long and 22 centimetres wide, pivoted on two bogies, one of which carries the motor, while the second is only a truck with two axles serving as supports. The motor and installation are according to the Siemens' system. The train weighs seven kilos empty, and is capable of carrying 25 kilos. The speed can be varied from 10 centimetres to 1 meter per second. The train, of course, obeys the host's order instantaneously, and our contemporary considers that the arrangement endows the dinner, "through this refinement of comfort and gracious politeness, with a special character of animation and 'friendliness.'" This installation certainly furnishes a new instance of the thousand-and-one services which electricity is called to render to domestic life. This particular departure is, of course, capable of considerable development, and who knows whether a few years hence some of our luxuriously-fitted hotels may not replace the obsequious waiter at the *tabled'hote* by electrical railways, served by a number of trains, under the superintendance of the *maitre d'hotel?*

CORRESPONDENCE.

From St. Louis, Mo.

ST. LOUIS, May 26.—D. W. Gurnsey, agent in this city for the Sprague Electric Motor company, is in the east giving the motor business a thorough study, both theoretically and practically. Success can be predicted for Mr. Gurnsey, for he is a man who never does things by halves.

The Ft. Wayne Jenney plant on the palatial excursion steamer, Grand Republic, is giving satisfaction.

The Cable Electric Light company is installing a 125 horse power Westinghouse engine; forty five 1,200 candle Excelsior arc lights and 1,350 light Westinghouse alternating plant. The lights are to be used in the spectacular play, "The Last Days of Pompeii," which is nearly three miles from the power house of the St Louis Cable & Western where the plant will be located.

The water commissioner will advertise for bids as soon as specifications are received from the printer for lighting the city water works and the surrounding territory. It is proposed to place at least ten lights on each water tower, which are respectively 200 and 250 feet high, also to light the numerous engine and pumping houses connected with the water works. The specifications require the candle power (actual measure) to be specified in the bids, also the actual horse power required per light.

The Heisler Electric Light company report business exceptionally good, as they can scarcely keep up with their orders.

The new Westinghouse compound engine is reported to be yielding one horse power hour on 18 pounds of water. If such is the case the price of electric light can be very much reduced and the business still be on a paying basis.

It is claimed by a representative of a leading electric company using the alternating system that with their new lamp they are able to run twenty 16-candle power lamps to the horse power.

Your correspondent witnessed the operation of a new regulator for dynamos the other day. It is the invention of a young mechanic in St. Louis, and performs its work to perfection. If the variation of the current is small the regulator moves slowly, but if there should be a short circuit, cutting out 10 lamps at once, the regulator moves so quickly that the current is never an ampere above the standard.

D. Crawford is talking of adding a 200 light incandescent machine to the already large electric lighting plant in his mammoth dry goods store. B.

New York Notes.

NEW YORK, May 26.—The favorable report of the aldermanic committee upon the petition of the Fourth avenue railroad to permit the use of electrical motors on their line, was not acceptable to the board, and was voted down by 14 to 10. The discussion upon the question was a most glaring exhibition of the prevailing ignorance upon electrical subjects in that august body. Of course, it was the most natural thing to be expected that the opponents of the petition should bring up the stereotyped arguments against electricity in general, although it appears doubtful if the current can be used in a more harmless manner than in the proposed method of operating street cars by storage batteries. The company, however, claims and will exercise the right of operating electric motors above Fourteenth street, and the successful operation of the road above that point will eventually lead to a popular demand for the extension of its use to the terminus of the line at the general post-office.

Quite a serious fire occurred at the Thirty-ninth street exchange of the Metropolitan Telephone and Telegraph

company on the night of May 23d, which is supposed to have been caused by the crossing of an electric light conductor with one of the telephone wires leading into the exchange. The fire started in the switch-board and made such rapid progress that the flames could not be subdued by the night force in charge, but the smoke was seen by a policeman on the street who at once turned in an alarm, and the fire department soon had the fire under control. The insurance patrol was of great service in protecting the switch-boards and instruments from damage by water, floods of which were poured into the building. Enough destruction was wrought in a few minutes' time, however, to temporarily paralyze the service through that exchange, but a large force of men was put to work next morning, who will be able to restore the service to its normal working condition within a week.

The coroner's inquest upon the death of the lineman Thomas Murray has been continued during the past week under Coroner Levy, who seems to have determined to excite popular interest in the subject. The attempt to elicit testimony from Mayor Hewitt was by no means successful. He claimed to know nothing about the case, and would not attempt to give his opinion as to the status of the law against overhead wires. He succeeded in arousing the ire of several jurymen, who were subsequently anxious to learn from the coroner whether he could be compelled to testify like any ordinary citizen. The mayor has been again subpœnaed to appear on Monday. Meanwhile both he and the coroner will study up the law, and probably the next cession will be an exceedingly lively one if his honor's physical condition is favorable.

Cornell university, always progressive, has made a decided innovation in the college curriculum by organizing a school of journalism, which will next year form a branch of the department of rhetoric under Professor Brainard G. Smith, formerly of the New York *Sun* staff. It is not the intention to graduate trained journalists, but to ascertain if the student's taste is likely to tend in that direction, and if so he will be given sufficient instruction to enable him to enter that field more thoroughly equipped than is ordinarily the case.

The Central and South American Telegraph company has brought suit against the Universal Interoceanic Canal company of France for $35,000 damages for violation of an agreement to relay their telegraph cables in Panama bay, and for nineteen days' consequent interruption of telegraphic communication, involving a loss of $28,000. The canal company agreed to remove the telegraph cables from their original bed in order to cut a channel and make a new trench. The work was done but the canal company declined to bear all the expense. The case has been transferred from the Supreme court of the State to the United States Circuit court.

A very interesting trial of speed between the Morse telegraph and the long-distance telephone for actual newspaper work took place this week under the auspices of one of the city papers. The test was made between New York and Boston, and in ten minutes the telephonist had transmitted 346 words while the telegrapher had sent but 330. The conditions, however, were the actual delivery of the matter, properly written out and carefully punctuated in readiness for the compositor. The result was announced in a dispatch from J. H. Holmes, of the Boston *Herald*, who said: "Telegraph message delivered all right and in shape for printers. Telephone message delivered in abbreviations that are not comprehensible to printers." Another trial has been proposed in which type writers will be used. P.

Kansas City, Mo.

KANSAS CITY, Mo., May 26.—Acting under powers which the city council recently conferred upon it by an ordinance, the Hallett Electrical Illuminating and Power company has filed its bond with the city comptroller, and will begin at once to erect buildings and put in an electric plant to cost from $60,000 to $75,000. The building of the company will be located at Twelfth and Franklin streets, and when the plant is in operation light or power can be furnished by it to any part of the city.

The Electric Time company filed articles of incorporation with Recorder Hinde a few days ago. The purpose of the company is stated to be to acquire, hold and sell patents and patent rights for the operation of clocks and other time pieces by electricity; to acquire, hold and dispose of franchises from cities, to maintain and to operate such machinery, and to manufacture, set up, lease or sell, electrical clocks and appliances for the transmission of time. The capital stock is $10,000 held by Messrs. Lumas, Hoyt Holmes, Willard P. Holmes and John D. S. Cook all of this city.

The United States Electric Lighting company have secured the contract for lighting the new board of trade building.

W. C. Stewart, of the St. Joseph Electric Light company was a visitor to the city this week, and was busy making calls upon members of the electrical fraternity.

C. H. Cone, of the Electrical Supply company, left today for St. Louis and a two weeks' trip through Iowa. As a result of his recent trip through Kansas he reports large sales of "P & B."

The growth and success of the American Electric Light of this city since its advent in the field of electric lighting is well worthy of note. The company's power house and central station is located at Twentieth and Central streets which is a capital location, as it is near the business portion of the city. The company started on the night of April 30, 1888, and at this writing has 75 arc lights in use, while their list of subscribers is constantly increasing, and to such an extent that they have found it necessary to increase their plant by the addition of 100 lights. The dynamos for this increase, and a 150 horse power New York Safety engine are on the road. The company have now three dynamos, two of 30 and one of 50 lights, belted direct from the engine, which is a New York Safety of 100 horse power. They have 12 miles of circuit up of P. & B. wire, and have just placed their orders with the Electrical Supply company for 10 miles more of the same wire, which will be placed on their poles at once. Workmen are now breaking ground for an addition of 40 feet to the building. The following named gentlemen form the company: M. S Porter, president and general manager, Wm. Russell, vice-president and mechanical engineer, O. W. Ditsch, superintendent and electrician H. M. Porter, secretary.

The National Bank of Kansas City building has been turned into a veritable electrical exchange, three large companies being already represented and more expecting to take quarters there. The Kansas City Electric Light company have three large rooms beautifully furnished. The Thomson-Houston Electric company, Chas. S. Rushing, agent, have fine rooms, decorated, carpeted and furnished in the latest and finest style. The Electrical Supply company, C. H. Cone, agent, also have finely furnished quarters in this building.

The Inter-State Electric company are now installing their central station in the Keith & Perry building. D.

Indianapolis Items.

INDIANAPOLIS, May 26.—The Cyclorama company have their building wired and wires for outside lights, and will have the engine and dynamo in position for opening May 30th.

At the meeting of the city council Monday night last, two street car ordinances were introduced, one for a new line by a new company, the other for an extension by the old company; both called for the use of motive power other than animal, and electricity and cables were mentioned. Both ordinances were referred to the committee on railroads.

The committee consisting of the city attorney, city civil engineer, one alderman and one member of the council, who have been on a tour of inspection for the past week or ten days, have returned and are busy making up their report. They visited several eastern cities where the electric light was used, also the factories of the bidders. They express themselves well pleased with what they have seen and learned while away. It is probable their report will not be ready to present to the council before the middle of next week, at which time there will be a special session called to receive and take some action upon it. From present indications it is likely the Thomson-Houston light will be recommended, although the members of the committee will not talk much on the subject. The Thomson-Houston bid was as low as any, and their light is as good as any seen, and several lights besides those of the bidders were examined both as to lighting power and expense. For some time the general sentiment among citizens seemed to be in favor of the city buying the plant after a certain time, but this seems to be declining.

The Lafayette, Ind., company who are preparing to run their street cars by electric motors, are about ready to begin operations. M.

From Little Rock, Ark.

LITTLE ROCK, Ark., May 22.—About the first of the year the mayor and city council of Little Rock advertised for bids from electric light companies to furnish a plant to light the city, and after considering several bids accepted that of the Fort Wayne Jenney Electric Light company for $27,000. The acceptance of this bid and the agitation of the subject have aroused considerable opposition among some citizens, not because they object to the light, but on account of the condition of the city financially; and a good deal of talk against W. G. Whipple, the mayor, has been the result. Ed. W. Parker, a banker, has been the most active in opposing the mayor and the electric light scheme, and has kept the daily papers well supplied with letters on the subject. Mayor Whipple was elected as a "boom" mayor, and while some of his acts are open to criticism, no one can really doubt his honesty and good intentions. Parker, in a late letter, charged the mayor with having ordered the issue of the warrants for the $27,000 to the electric light company before the city had received any consideration or security from said company of any kind, and to-day's issue of the Arkansas *Gazette* contains another communication from Mr. Parker, together with a statement by the mayor, and interviews with the city attorney and clerk in regard to the electric light matter, especially that part of the controversy wherein Mayor Whipple is charged with doing a wrong in ordering the city clerk to issue the $27,000 in warrants on account of the Fort Wayne company. The testimony all goes to show that the mayor, who gave this order without consulting with his associates of the board of public affairs, never for a moment contemplated having the warrants issued in fact and given to that company. He wanted them made out and held by the city clerk so as to show them to the agent of the company on his arrival here, as evidence of good faith on the part of the city that they meant to carry out their part of the contract. They were not to be signed or to leave the custody of the clerk. The mayor may have acted hastily, but as far as any wrong doing on his part there is no evidence. He was simply trying to get everything in as good shape as possible to get the Fort Wayne company to do the work for the city.

The matter has taken another turn, however, in the shape of a bill in chancery to prevent the city from fulfilling its contract.

Thomas W. Baird for himself and others asks for a restraining order to prevent the city of Little Rock, W. G. Whipple, M. G. Hall, Max Hilb and H. Clay Jones from making the contract for lighting the city, with the electric light company, and to prevent the issuance of warrants to the amount of $27,000. Mr. Baird was represented by U. M. & G. B. Rose, and the city by its attorney, W. L. Terry. Mayor Whipple was also present at the argument before Chancellor Carroll. The bill alleges: . . . "The said mayor and other officials of said city made defendants herein, are now threatening to carry said contract into effect, and to issue warrants of said city for $27,000 to said electric light company; and plaintiff charges and believes that they will do so unless restrained by order of injunction from this court. Your orator prays that a preliminary order of injunction restraining said defendants, attorneys and servants from taking any further steps toward the enforcement of said supposed contract, and particularly that said city and its said officers may be enjoined from issuing any warrants, or other evidence of debt, under said contract or in payment of the work or material therein stipulated for, and from paying out any money for the same, and that on a final hearing it may be decreed that said contract is wholly illegal, null and void; and that said defendants may be perpetually enjoined from enforcing the same, or carrying the same into effect, and for all other proper relief." Mayor Whipple stated that no notice of the filing of the bill had been given him. Judge Rose said that he did not want to take any advantage of the mayor, but wanted the mayor not to issue the warrants until the case is decided. The chancellor agreed to this, and the case was thereupon continued until some day to be agreed upon by the attorneys. It remains to be seen yet whether there is anything in the suit.

The Erie Telegraph and Telephone company has been very busy putting in new telephones and increasing its plant since the first of May, when the injunction against the Southern Telephone company went into effect. They have placed 78 telephones since the 1st, and have upwards of 40 more to put in. This will make upward of 400 connected with the exchange, with good prospects of the number being increased to 500 before the close of the year. The Southern Telephone company, which had been in operation for over two years, had expended large sums in constructing its plant, and had about 480 instruments in use. They used Long, Pan electric, Turnbull and Emner telephones, and thought themselves injunction proof. But the Bell company "did them up," and the whole plant is now idle and silent. There is some talk of their trying the Writing telegraph.

The Yell County Telephone company, using the Bay instruments, have been enjoined by the Bell company, in consequence of which, communication with the interior is cut off, except by the old and slow process of the mails. The people did not fully appreciate the advantages of the telephone until they were deprived of the use of it. A.

St. Louis Telephone Rates.

ST. LOUIS, May 26.—City Counselor Bell proposes to test the validity of the ordinance making it a misdemeanor to charge more than $50 per year for the rental of a telephone. The bill was passed last March, and became a law April 1st. The Bell Telephone company, which is the only concern affected by the ordinance, has, it is claimed, reached the conclusion that the municipal authorities have no power to regulate telephone charges, and have manifested no intention, it is said, to change the annual rental of telephones from $100 in compliance with the ordinance. City Counselor Bell, who has been giving the matter his attention for several weeks, with a view to testing the ordinance, last Saturday instituted a prosecution against the officers of the Bell Telephone company, charging them with violating its provisions in refusing, on April 10 last, to furnish Louis C. Bohle telephone service at 1122 Chestnut street, at the rate of $50 per year. It is expected that the case will reach the Supreme court before the October term of this year. An effort will be made to secure its advancement on the docket so as to get an early decision. City Counselor Bell will represent the city in the prosecution of the case. He holds that the ordinance is constitutional, and that the municipal assembly has authority to regulate telephone rates as well as ferriage and other rates.

The case will be watched with considerable interest by those using telephones, who would, as a matter of course, much prefer to get the use of the instruments for $50 per year than $100, the rate they are now paying. At a meeting of the citizens using telephones, held at the Lindell hotel about a month since, it was the unanimous opinion that the ordinance should be enforced.

When the bill was before the house of delegates, where it was originally introduced, the representatives of the company presented arguments to show that the corporation would lose money if the rate was reduced. The company made no effort to secure its defeat in the council, having, it is said, been assured by its legal advisors that the Assembly had no authority to regulate the charges.

McD.

The Enos Electric Railway, at St. Paul.

PRESIDENT'S OFFICE, THE ENOS ELECTRIC RAILWAY COMPANY, ST. PAUL, MINN., May 22—I notice in your issue of May 19th reference to the electric railway in St. Paul; allow me to enlighten your readers a little further in regard to the merits of this road. The system in use is the Enos elevated electric railway; and while being, as you say, the first electric railway in Minnesota, it is, also, the first *elevated* electric railway in operation, as I believe, in the *world*. This road is in daily operation in South St. Paul, and attracts very great attention.

For many months, tiresome experiments were performed in trying to perfect the electrical appliances, but without success. Finally an order was given to the Thomson-Houston Electric company, of Boston, for four of their motors, which were taken directly from their warerooms without previous especial structure for this purpose; with slight alteration in adjustment here, they were placed above the car on our track and the current turned on; without the slightest hesitation, the car moved forward, and has continued to do so at every request of the operator from that time since.

The first twelve hundred and sixty feet of our track is upon a six and a half per cent. grade; and we make this grade with a load of passengers without difficulty at not less than fifteen miles an hour, thus clearly establishing the fact beyond question that elevated railways can be operated by electricity; that the Thomson-Houston company has machinery developing sufficient power, and under thorough control, to be adapted to this especial work. We have, also, demonstrated that the Enos system of elevated railway is the most perfect and best adapted for street railway purposes, where rapid transit is required, of anything in use to-day; and it is with great pleasure that we present these facts before the public, hoping, thereby, to call to their notice the merits of this system, and the advantages to be derived from its use.

J. H. LAWRENCE.

Kansas Notes.

ATCHISON, May 26. — Atchison is to have anothe electric light company, the Atchison Electric Light and Power company. The capital stock is $3 0,000, and the directors are J. P. Pomeroy, A. G. Otis, J. P. Brown, E. S. Wills and J. M. Chisham. The company is really the old gas company, which has secured a charter for an electric light plant. The new company will probably add the electric motor system to its plant. A lively cutting of rates is expected when the new company is ready to supply lights.

T. M. Wilson, who has been employed by the Hutchinson Water, Light and Telephone company for about two years as manager of the telephone and electric light department, has severed his connection with that institution and will sail for Buenos Ayres, South America, where he will engage in the same business. E. M. Van Frank, who has been for some time engaged in wiring buildings for the electric light service, will accompany Mr. Wilson.

McD.

THE ELECTRIC LIGHT.

The Waco Gas company, Waco, Tex, will put in a Jenney Electric plant.

Scenes in "Paul Kauvar" were photographed by electric light at Hooley's theater last week.

Two hundred arc lights will illuminate the factory of the Western Electric company in New York City.

Lightning struck the electric light wire at Decatur, Ill., last Monday and several poles were shattered.

South Boston, Va., will be lighted by the Brush system. The Ball Engine company will furnish the steam plant.

W. & A. McArthur, of Cheboygan, Mich., have ordered a 50 light arc plant of the Thomson-Houston company of Chicago.

Gadsen, Ala., will be lighted by electric light. A stock company has been formed, and all the shares have been subscribed for.

The Silvey Electric company of Lima, O., will install a 75 light plant in the Sherman Cottage located about six miles from Cincinnati.

The loss of the Edison Electrical Illuminating company of New York, by the fire in the Liberty street plant last week will be about $10,000.

Gilman & Hudson, have ordered a plant of 50 arc lights of the Thomson-Houston company, of Chicago, for street illumination at Madison, Wis.

The Bay State Lumber company of Menominee, Mich., has ordered a 150 incandescent plant of the Thomson-Houston company, of Chicago.

An incandescent plant has been installed in the Baylor Female College at Waco, Texas. An Edison dynamo and Westinghouse engine are employed.

The Thomson-Houston company of Chicago, will install a 800 light incandescent plant for the Fort Scott, Kan., Electric Light and Power company.

The Excelsior electric lights have been introduced into Elgin by a company, of which William Hubbard is manager. A project for using these lights for city illumination is under consideration.

At a recent meeting of the New York Fire commissioners it was voted, in order to better locate the different fire signal boxes at night, to have the globes of the electric lamps nearest the alarm boxes painted red.

A committee of the city council of Urbana, O., was in Lima, last week, inspecting the working of the Silvey company's electric light system with a view of its adoption in Urbana. The estimated expense of the plant is $20,000.

M. W. Plake, a lineman of an electric light company, was injured last Monday at 183 State street, Chicago. He was repairing some wires, and on account of defective insulation received a severe shock. His injuries are not serious.

The Peninsular Electric Light and Power company of Houghton, Mich., increased its plant last month by ordering 30 arc lights of the Thomson-Houston company of Chicago. The company has just ordered a similar number of arc lights for a second increase in its plant.

Owing to the failure of the United States Electric Lighting company, of Washington, to put its wires along Pennsylvania avenue from Eighteenth street to Washington circle and on New York avenue and Fourteenth street underground, the lights are not to be paid for after June 1st.

The Edison plant in the Rookery, Chicago, consisting of four dynamos each of 900 lights capacity, is nearly ready to run. This plant is of magnificent construction throughout, and is one of the largest, if not the largest isolated plant in the country. About 4,500 lights will be connected.

Red Bank, New Jersey, owing to the enterprise and genius of one of her prominent citizens, D. N. Applegate, is now boasting of having a Heisler incandescent central station plant. It is supplying very extended commercial and city circuits and has proved a fierce competitor to the gas company. Seventy street lights of 30 candle power are furnishing illumination for six miles of streets, and are supplied at the rate of $24 each per annum.

The construction of the central station plant in Wabash, Ind., for the illumination of the city by the Heisler system is progressing very rapidly. The pole line and circuits for nearly twelve miles of streets have been brought near completion within barely two weeks, and it is expected that the plant will be started on the first of June. This incandescent plant will supersede the tower lighting installed in 1885, which has had certain historical distinction in having been the first installment of the kind on this continent.

A dispatch from South Pittsburgh, Tenn., states that a representative of the Silvey Electric company is in that city. South Pittsburgh has long felt the need of electric lights; the streets are bereft of any kind of illumination whatever, save that which nature supplies, and many are the injuries received and emphatic words spoken by pedestrians who fall in the divers holes, mud puddles, ditches, etc., which abound throughout the city. The merchants are ready, to a man, to support a company by using the incandescent lights in their stores and residences.

M. Lyon Alemand has given notice of a resolution in the Paris municipal council, proposing that the sum of 20,000fr. ($4,000) be awarded for the invention of a perfectly satisfactory current meter; the sum of 10,000fr. to be awarded as first prize, five premiums of 2,000fr. to the next best inventions. Should it be possible to use the meter with one kind of current only, continuous or alternating, then one-half of the above premiums would in that case be awarded. Finally, with a view, doubtless, of recouping themselves, the council are to reserve the sole right to manufacture the successful meters, no royalties being paid to the inventors.

The frequency of conflagration caused by electric light wires induced the Electric club of Philadelphia to inquire into the means of preventing them. At a recent meeting, the report of a committee of four months' standing was presented, in which the various automatic cut-outs proposed by different inventors were considered, some utilizing the heating of a wire, some the action of a spring pulling against the armature of a magnet. The old arrangement of a fusible alloy cut-off was pronounced objectionable on account of the interruption produced when it melted, but this was obviated by an arrangement for throwing other fusible pieces into the circuit one after the other. Thus a momentary increase of current would only cause a momentary stoppage.

The lighthouse board has perfected arrangements for the illumination of Gedney's channel, in New York harbor, by electricity. Six electric light buoys will be placed, three on each side of the channel, about 1,100 feet apart. They are expected so to light the channel that vessels can enter the harbor at night as safely as in the daytime. The dynamo station will be at Sandy Hook. To establish these lights will cost about $26,000, and they can be maintained at a cost of $3,000 a year. Captains of steam and sailing ships, both in the ocean and coasting trade, express great satisfaction at the proposed innovation. The Sandy Hook pilots, while not so enthusiastic, are in favor of the scheme. "Will not the brightness of the lights bother pilots as the East River bridge lights are said to do?" asked a reporter of a pilot. "No," the latter replied, "the lights will be so low down that I don't anticipate any trouble from that source."

D. R. Walker, engineer of the Philadelphia city council, has sent in his annual report to the mayor, describing the working of the underground cables. The Brush company are using sixty arc lamps in one of their circuits, which is five miles long, and is worked at a pressure of 2,800 volts, or about 45 volts per lamp. The lamps are generally placed at intersections of streets, and at a distance of about 500 feet apart. The cable for the Brush lamps consists of a seven strand 14 B. W. G., with insulation of from one-sixteenth inch to three thirty-seconds inch, and protected with a lead covering one-eighth inch thick. The same cable is used by the Keystone company in a fifteen mile circuit at 2,000 volts, and no difficulty has been found in working it. Along Chestnut street the electric light cables are laid side by side with telephone and telegraph cables in a cast-iron duct 20 inches by 30 inches. The Broad street cables are laid in a wooden trough covered with a plank and close under the pavement. Nine-tenths of the difficulties experienced with underground work were not in the cables themselves, but in the connections with the overhead portions. Mr. Walker mentions a case were lightning struck an overhead connection on an underground circuit, ran through three miles of cable, and burned the dynamo, but did not affect the cable.

THE ELECTRIC MOTOR.

The Street Railway company; of Seattle, W. T., has decided to issue bonds to the amount of $60,000, to convert the present street railway into an electric motor line.

Friday of last week a Baxter motor of two horse power was started in Milwaukee. The Badger Illuminating company of that city have just established a power circuit similar to that in Chicago.

Baron Gostkowski recently read a paper in Vienna advocating the use of accumulators for street car propulsions. He showed by calculation, and by the result of experiments made with accumulators, that in using this power a much greater speed can be obtained than with horses, the cost being about the same. He ended by expressing the view that this mode of traction would soon be adopted in Vienna.

A correspondent in Madrid mentions that an officer in the artillery corps has been constructing a submarine torpedo boat of which the motive power will be electricity. The boat will carry 160 large accumulators, and a 60 horse power Oerlikon electric motor. The accumulators are claimed to surpass all others now existing for storage capacity and duration, but the materials employed are kept strictly secret. So far no patent for the accumulators has been taken out and it seems to be the intention to make their construction a war office secret. The accumulators have been tested for some months, and their storage capacity and rate of discharge are remarkable high.

The New York and Harlem railroad company, in New York city, will soon begin to use accumulators on its cars running above Fourteenth street, although the aldermen will not give permission to operate the city below that street. An ordinary man can run the car after a day's instruction. The batteries are placed in the car in eight trays, four on each side of the car, through panels on the outer sides, which when closed, leave the appearance of an ordinary car. It is estimated that a car equipped with charged batteries can run from twenty-five to forty miles. The changing of batteries will take no more time than is required to change horses. The service of stablemen is dispensed with, and it is claimed that the cost will be less than that of horse power.

A motor of novel design has been made at Cologne, in order to decrease the difficulty in starting the cars. The motor has field magnets connected with the wheels of the car; the armature revolves loosely on the same shaft, but its revolution can be checked by a brake, when the field magnets begin to revolve, driving the car. The driving wheels

have also a brake, which is connected with that previously mentioned, so that by taking the brake off the armature the brake on the driving wheel is put on, and *vice versa*. The motor is started at full speed, allowing the armature to revolve, as its motion is gradually stopped by the brake, the motion of the brake handle releases that of the driving wheels, which gradually revolve faster as the armature stops.

When the New York common council refused to give the Fourth ave., street car company a franchise to run cars by accumulators the New York papers openly charged that consent was withheld for the purpose of extorting money. The *Sun's* sweet poet sung several verses on the theme. The following are samples:

"No, no," an Alderman declares,
"We do not mean to vote, or
Make any move, except on shares,
For your electric motor.
And so—you needn't get your back up—
You'd better whack up.

"Electric motors may be just
What people now are needing;
But where's our cash? We never trust
And vain is empty pleading.
Last chance—before our traps we pack up,
You'd better whack up."

THE TELEPHONE.

The officers of the Bell Telephone company, of Buffalo, propose to prepare plans at once for putting under ground a portion of their wires in Rochester, N. Y.

"I say, Jack, they've got so now that they can draw pictures on paper by telegraph."

"Pooh! that's nothing. I've drawn drafts on my guv'nor by telegraph for the last three years." —*Harvard Lampoon.*

The executive board of Rochester, N. Y., has granted permission to the Bell Telephone company to construct underground conduits in East Main street. The work will be done under the direction of the chief engineer of water works and superintendent of fire alarm telegraph.

It is expected that the new switchboard of the Metropolitan Telephone and Telegraph company of New York will be ready to receive the wires about September 1st. It will cost about $350,000, and will accommodate 10,000 subscribers. The length of the switchboard is about 300 feet, which will make it the largest in the world.

A New York dispatch says: In the United States Circuit court to-day Judge Wallace rendered a decision in favor of the plaintiff corporation the suit of the American Bell Telephone company against the Universal Dynamophone company for infringement of the telephone patents. An injunction in favor of the Bell company was granted and an accounting ordered.

Personal Paragraphs.

Walter K. Freeman, of the Fort Wayne Jenney Electric Light company, was in Chicago the latter part of last week.

George L Roberts, of counsel for the American Bell Telephone company, arrived in Chicago Wednesday to participate in the litigation now in progress with the Cushman company.

John R. Dee, an enterprising electric light and power man from Houghton, Mich., was in Chicago two days last week. The multiplicity of his business affairs precluded anything but a very brief call at the WESTERN ELECTRICIAN office.

Thos. D. Lockwood, of Boston, whose name is known to every telephone man in the country, and whose series of papers on "Practical telephony" in the WESTERN ELECTRICIAN has attracted widespread interest, took a flying trip to Chicago last week and paid this office a short call.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	400
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	27	28
Missouri and Kansas	70	71

Miscellaneous Notes.

A Vienna engineer has patented a smoke abating process. By means of electricity he proposes to condense the solid part of the smoke as it rises from the coal, the carbon thus formed falling back into the furnace.

In the suit of the Water, Light and Power company against the city of Carlyle, Ill., for refusal to accept and pay the first installment on the water-works plant recently erected by the company, because the water pressure was not up to the standard stipulated for in the contract, Judge Ames decided for the defendant.

The Virginia agricultural, mechanical and tobacco exposition will be opened at Richmond, Va., October 3d and closed not later than November 21, 1888. Section 23, of department H, will be devoted to the exhibition of electric apparatus. Applications for space should be made to Henry C. Jones, director general, Richmond, Va.

The New York *World* thus comments on the French copper syndicate's operation: "This order of things cannot last very long. The supply, stimulated by profitable sales, will exceed the demand, and it is only a question of time when the parties who try to buy and carry the surplus will, if they persevere, be overwhelmed by it. The world is a very large place, and the individuals who combine to control any one of its products that is not necessarily limited in quantity, undertake, as a rule, more than they bargain for. They are not only surprised at the quantities they must pay for, but at the extent to which people can do without things that are made unduly expensive. It requires very shrewd and prompt work for the manipulators of a corner to shift the burden on other shoulders and escape with a profit before the collapse in the market comes. Very few possess the requisite ability. And it is a matter for rejoicing that such is the case. It is to be hoped that the Frenchyn discate will go the way of its numerous predecessors, and the presumption is that it will."

Following is a circular issued by P. H. Alexander, president, and Henry B. Cram, secretary, 48 Congress street, Boston, of the New England Electric exchange, setting forth the object of the association. A brief mention of the formation of the exchange has already appeared in these columns: "As a result of various conferences held between gentlemen interested in insurance matters and others engaged in electrical business, at which the matter of diminishing risks to property and life by a more thorough installation of electric light and power plants and the employment of the most competent men for their operation were discussed, the New England Electric exchange was formed and a constitution and plan of licensing was adopted, copies of which we enclose herewith for your earnest perusal. The constitution will inform you whether you are eligible to membership in this body and the advantages you may derive by joining it; the plan of licensing will instruct you how to obtain a license for any of your employes and the forms sent with this circular will facilitate your doing so. After October 1, 1888, the fire underwriters will not insure any property where electric light or electric power is used, nor pass any new installations unless the party operating the plant or making the installation has obtained from this exchange a certificate of license. The examination for the different classes of licenses to be granted will be practical in their nature and no competent workmen will be ruled out nor will there be any discrimination for or against any system of electric lighting or electric power. In order to inconvenience applicants for licenses as little as possible, no permanent board of examiners will be appointed, but examiners will be selected for the different localities application is made from, and such gentlemen chosen as examiners as are most familiar with the practical work for which the application for license is made. Due notice will be given to applicants for licenses of the time and place of examination. The fee of $2.00 must accompany the application for license to help defray the expenses of the examination and will not be returned should the applicant fail to qualify. Copies of all forms and blanks may be had upon application to the secretary of the exchange."

Business Mention.

Leonard & Izard have moved into their elegant quarters, 425 The Rookery, Chicago.

The office of the Gibson Electric company of New York is now at 775 Greenwich street. This company manufactures storage batteries for all the purposes of light and power.

W. S. Hill, of 133 Oliver street, Boston, Mass., has issued a catalogue devoted to the details of his electric light system, which was recently described in the WESTERN ELECTRICIAN.

The Western Electric company of Chicago is receiving large numbers of orders for cables. The Missouri & Kansas Telephone company has ordered two miles and the Pittsburgh Telephone company has ordered five miles. The American District Telegraph company of Omaha, has ordered 100, Field & Firman 11 call boxes.

Chas. A. Schieren & Co. of New York, report recent sales of their leather link belting to the following electric light plants for use on dynamos: Florence Electric Light company, Florence Mass.; Scranton Illuminating Heat & Power company, Scranton, Pa.; Thomson-Houston Electric company, Lynn, Mass.; Narragansett Electric Light company, Providence, R. I.; Sheffield Electric Light works, Sheffield, Ala.; Home Electric Light company, Tyrone, Pa.

W. W. Munro, manager of the western department of the Baxter Electric Manufacturing & Motor company, room 30, 130 Dearborn street, believes in preparation for any emergency, and consequently has on hand in his office a full line of parts for the various sizes of motors made by this company; consequently in case of accident he is ready to fill an order for any part immediately. A case in point: A motor shipped to Milwaukee, when unpacked was found to be damaged. Due to careless handling, a part of a yoke lever, which from its very construction would almost never wear out in operation, was bent and almost useless. A telegram to the Chicago office brought a duplicate yoke lever by the first express and the motor was at once installed. But for the fact that a stock of all the parts of the motor was carried, a delay of a few days instead of a few hours would have resulted.

Electrical Patents.

Issued May 22, 1888.

383,095. Differential Expansion Device for Galvanometers. William H. Bristol and William E. Geyer, Hoboken, N. J.

383,096. Anti-Induction Composition for Electric Cables. David Brooks, Jr., Philadelphia, Pa.

The claims are given: "1. A composition, for the purpose set forth, consisting of plumbago, gum-copal, linseed oil, and turpentine.

"2. A composition, for the purpose set forth, consisting of a carbonaceous gum composed of a powdered electrical conducting material, gum-copal, linseed oil and turpentine.

383,097. Support for Electric Wires. David Brooks, Jr., Philadelphia, Pa.

383,098. Covering for Electric Wires and Cables. David Brooks, Jr.

383,105. Electrophorus. James D. Culp, San Felipe, Cal.

The invention relates to the construction and application of the apparatus known as electrophorus for generating electricity, by the inductive action of an electrified plate of non-conducting material upon a plate metal which is alternatively applied to and removed from the inducing non-conductor. The object of the invention is threefold: first, to increase the efficiency of the electrophorus as an electrical generator; second, to employ it as a means for generating ozone; and, thirdly, to fit it for certain special uses as an ozone-generator or otherwise.

The first and last claims are given:

"1. In an electrophorus, and in combination with the inducing and induced plates thereof, the sole provided with an insulating plate or cover on the opposite side from the inducing plate.

"23. An electrophorus having a non-conducting backing on the induced plate and sparking points or electrodes on the said backing in the discharging circuit of said induced plate."

383,114. Automatic Tightening Device for Armatures of Dynamo-Electric Machines. James W. Easton, New York, N. Y.

The invention consists in providing means for automatically tightening the armature whenever it is necessary by the operation of the machine itself.

383,140. Manufacture of Incandescent Electric Lamps, Otto A. Moses, New York, N. Y.

The invention relates to the construction of the globes of incandescent lamps and to means of attaching the same to a holder and securing electrical connections between the leading-in wires of the filament and the conductors of the holder. Claims 4 and 7 read—

"4. The combination, with an incandescent electric lamp, of a solid glass block secured in the neck of the lamp and a central electrical contact point sunk into said block.

"7. In an incandescent electric lamp, the combination, with the globe, of a central contact point, a leading-in wire passing through the same, and an independent supporting block of glass surrounding the contact-point."

The third and last claim is as follows:

"3. A secondary battery element composed of a single continuous metallic plate provided with a series of holes through its body parallel with its sides."

383,158. Combined Gas and Electric Light Fixture. Samuel B. H. Vance, New York, N. Y.

383,184. Electrical Apparatus for Purifying Water. Albert R. Leeds, Hoboken, N. J.

383,193. Secondary Battery. John S. Sellon, Sydenham, County of Kent, England.

The invention consists in a construction and arrangement of the elements whereby any individual member or one element of a series may be removed without disturbing the remaining elements, or interrupting the continuity of the circuit in which the battery is located.

383,216. Secondary Battery. Ludwig Epstein, Martinikenfelde, near Berlin, Prussia, Germany.

383,220. District Telegraph Call Box. James B. Gill. San Francisco.

383,263. Galvanic Battery Excitant. Thomas P. Whittier, East Saginaw, Mich.

The claim is as follows: "An excitant for galvanic batteries, composed, essentially, of a solution of the residual salts from natural brine."

383,269. Telephone Conveyer. Samuel R. Ballard, Pittsburgh, Pa.

The invention consists in a complete telephone set, which may be sent to any floor or any part of the building to the party wishing to use it instead of having the person go to the office. The claim reads:

"The combination of the elevator ways traversing two or more floors of a building, a carriage guided in said ways, a telephone transmitter, receiver, magneto call bell, and battery mounted thereon, and having automatic switch, line, and ground connections constantly connected to said switch, a counter-weight for the carriage and its contents, and an operating rope attached to said counter-weight at one end and at the other to the movable carriage.

383,271. Battery Zinc. John Beattie, jr., Fall River, Mass.

383,273. Electrical Tramway. Henry T. Blake, New Haven, Conn.

383,274, Electrical Tramway. Henry T. Blake, New Haven, and Clarence Sterling, Bridgeport, Conn.

383,320. Dynamo Electric Machine. Lawrence N. P. Poland, Cincinnati, Ohio.

383,332, Combined Gas and Electric Light Fixture. Samuel B. H. Vance, New York, N. Y.

383,345. Rheostat. Frank J. Crouch, Eugene City, Oregon.

383,377. Fusible Coupling for Electric Fire Alarm Circuits. George G. Smith, St. Albans, Vt.

The claim is as follows:

"The improved coupling for closed electric fire alarm circuits, consisting of a tube of fusible metal adapted to receive the ends of the circuit wire and a weight fixed centrally upon said tube."

383,385. Testing Machine. Arthur V. Abbott, Brooklyn, N. Y.

383,411. Electric Lamp. Eli C. Ohmart, New York, N. Y.

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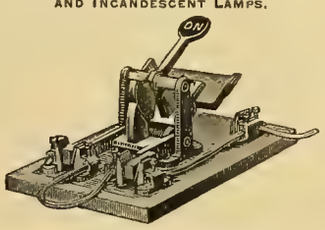

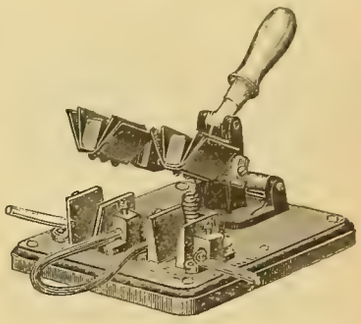

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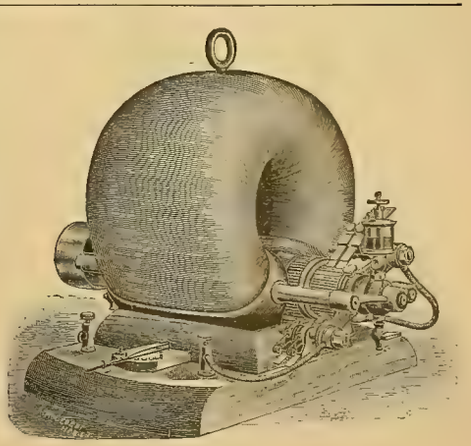

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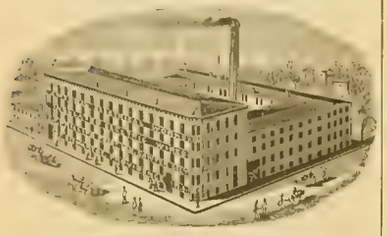

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[Extract from the annual message of Hon. Timothy Nester, of Marquette, Mich.]
"Mr. Fred H. Whipple, of Detroit, Mich., who was directed by the Detroit Board of Aldermen to procure all obtainable information on the subject of Municipal Lighting, has kindly sent me advanced sheets of such portions of the report as bear upon the question which you will have to consider, and I gladly submit them to you to be placed before the incoming council for its information and guidance. The report is exhaustive and highly valuable."

[Extract from council proceedings.]
"Mayor Clark—In connection with these very instructive and interesting reports of Mr. Whipple, which will furnish the basis of information for the action of the city in the future, is the announcement that the matter will be published in book form. The book will furnish a large amount of information. What shall we do with these documents and this communication?"
"Alderman Hennessey—I move they be placed on file for future reference."
"This was seconded by Alderman Conners and unanimously carried."

[Extract from Mayor Clark's speech.]
"We have listened, and with great interest, to the communication received from Mr. Whipple, and it is to me, and no doubt it is to you, a very instructive and entertaining document, and will furnish information for our future guidance. We certainly have reason to be grateful to him for his instructive reports."
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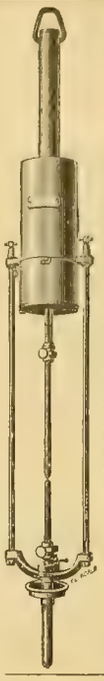

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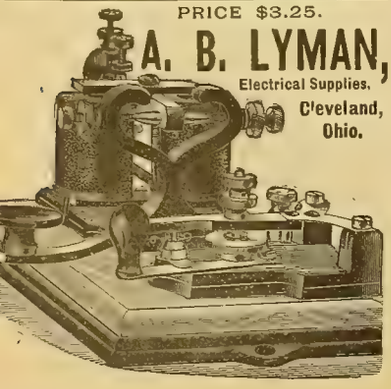

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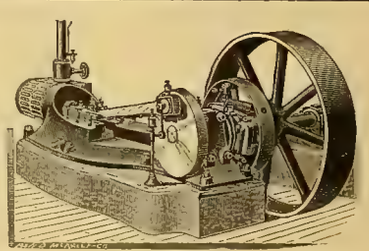

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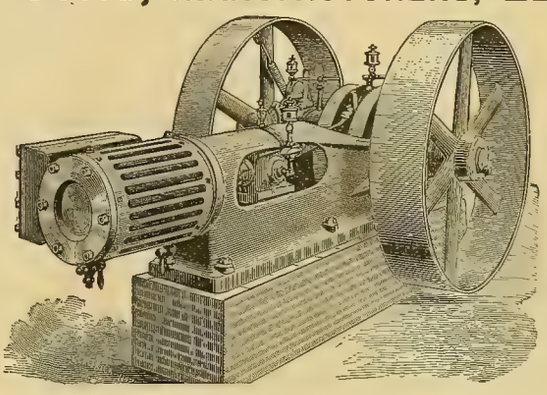

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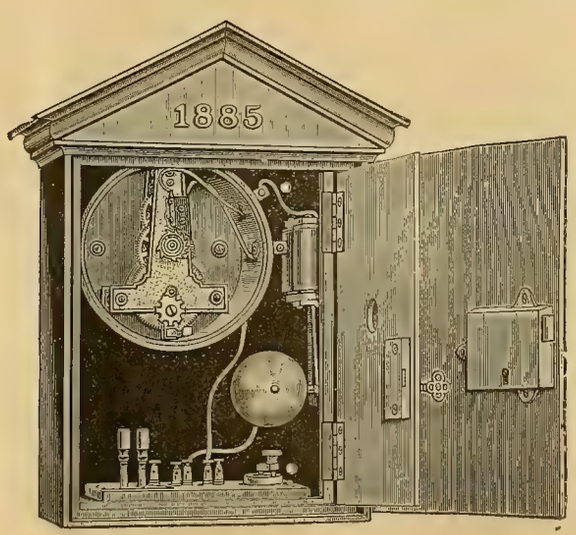

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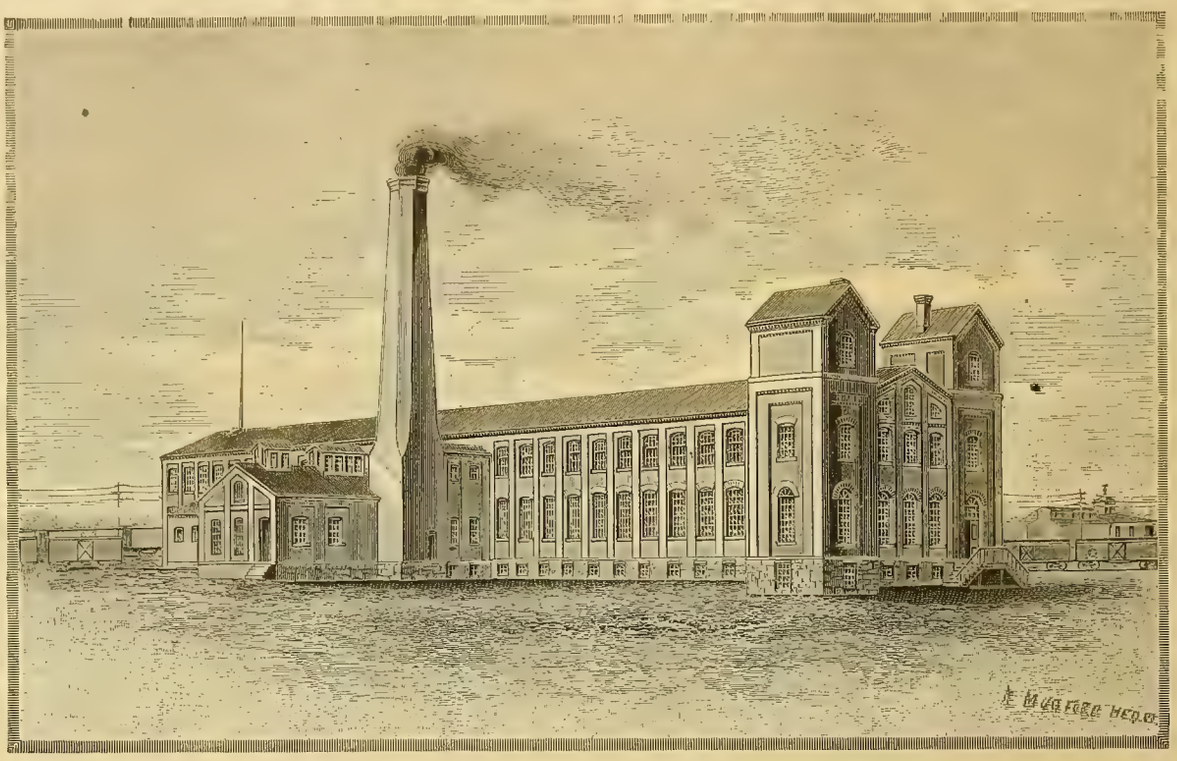

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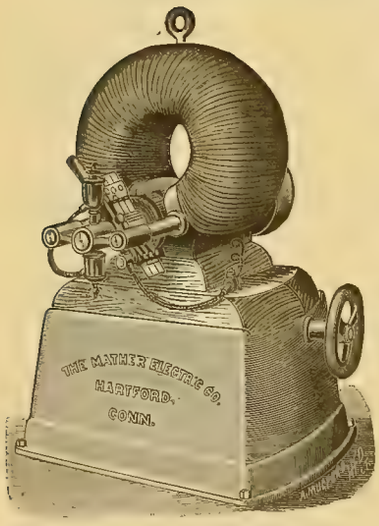

The Dynamos of this system are equal to any in efficiency. The lamps are adapted to a higher potential than those of any other system, have no superior in life or efficiency, and

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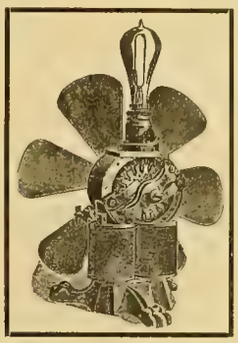

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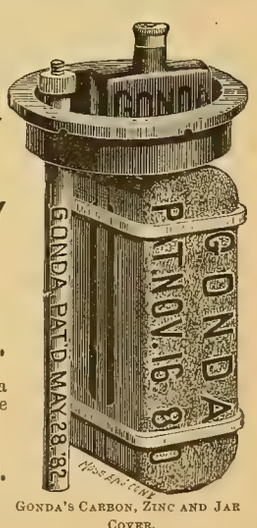

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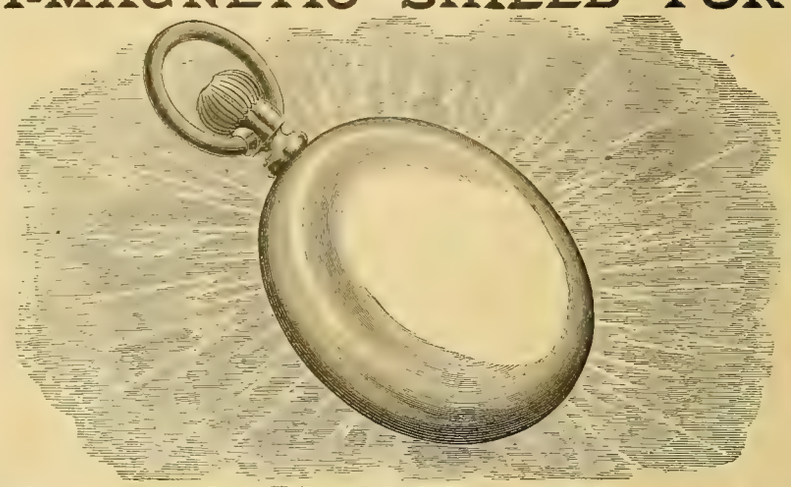

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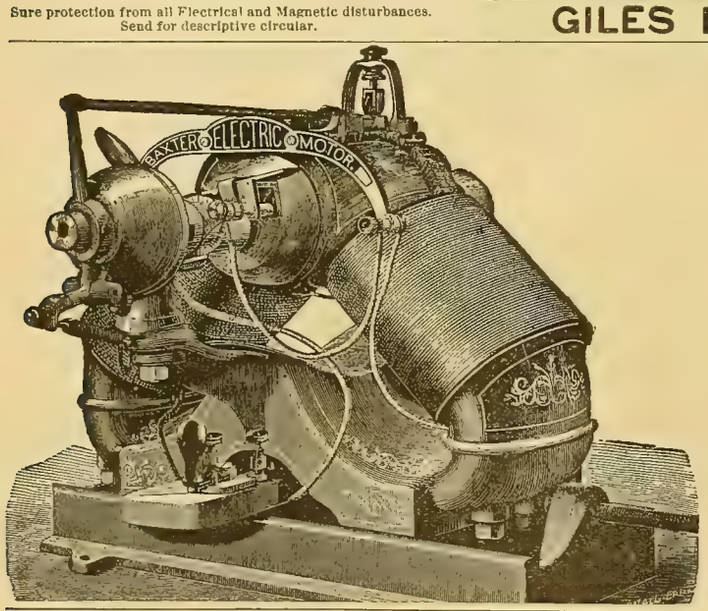

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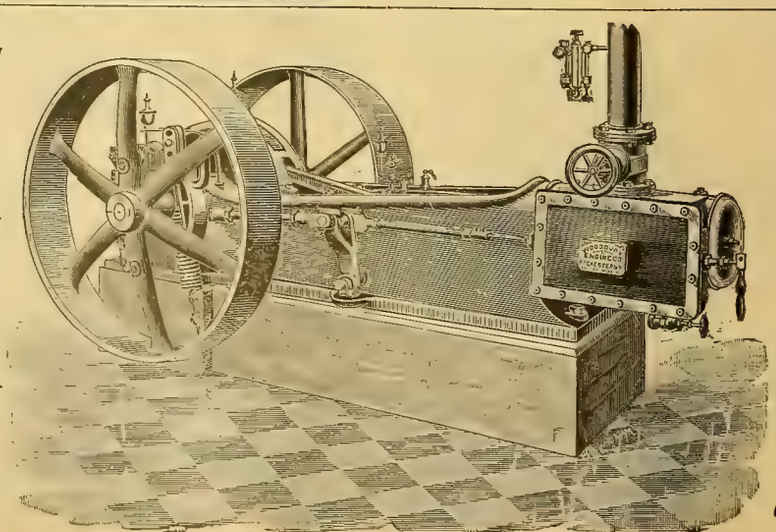

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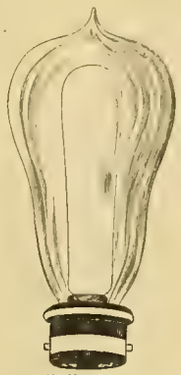

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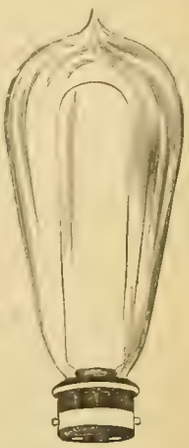

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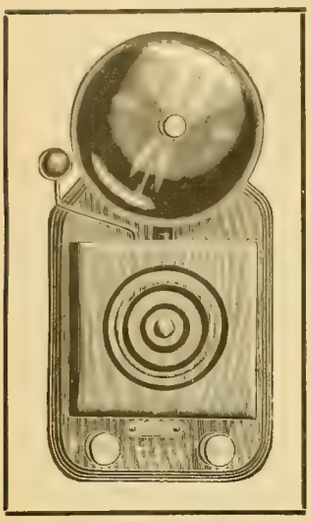

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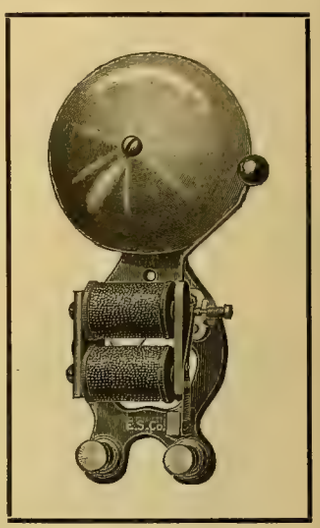

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We aim to supply the best goods for the least money.

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Don't you sometimes feel like using your fist
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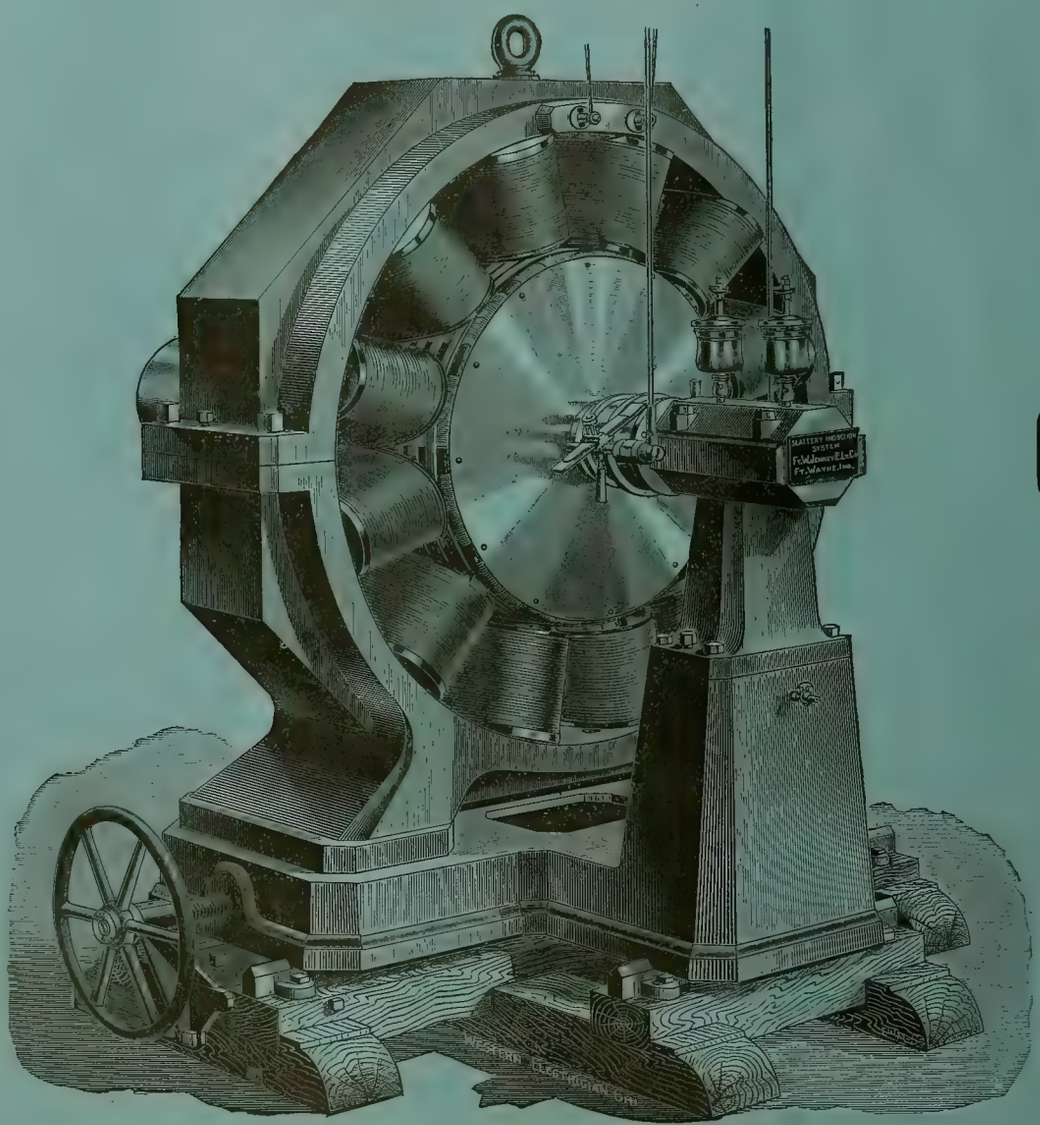

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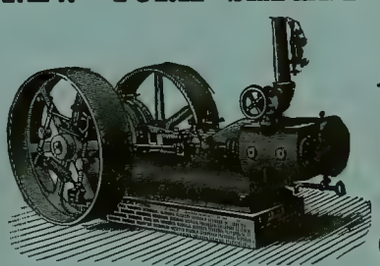

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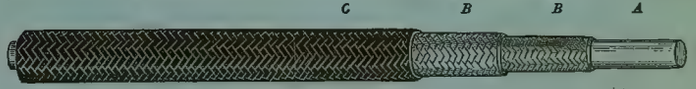

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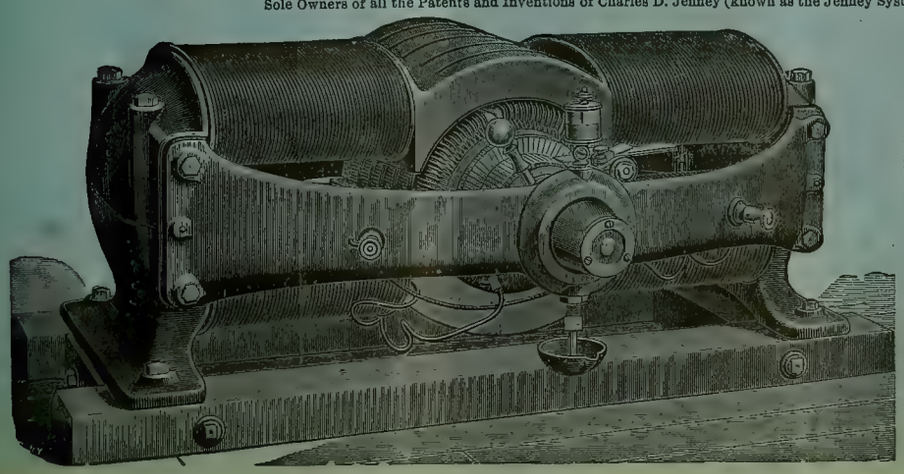

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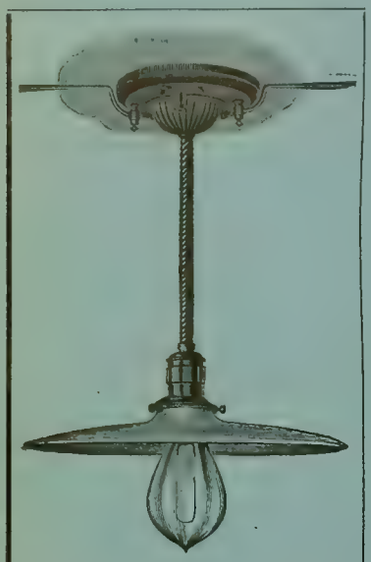

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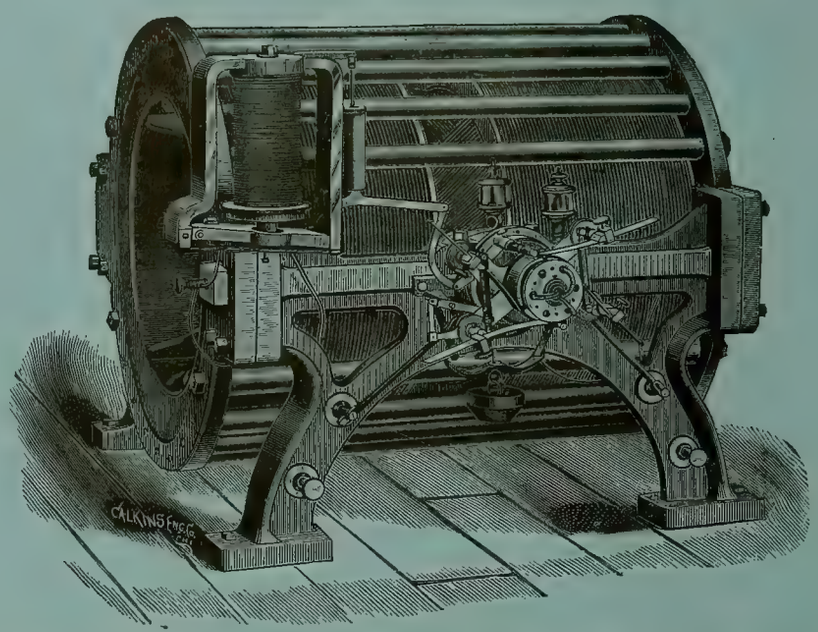
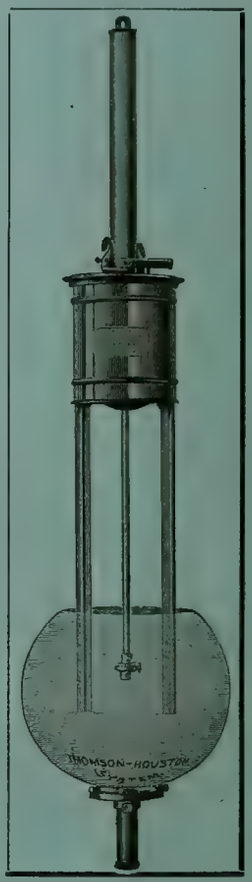
First Prize: Best System of Arc-Lighting,
Cincinnati Industrial Exposition, 1883.



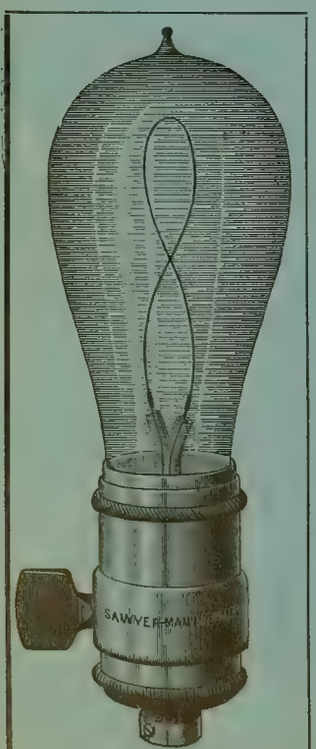


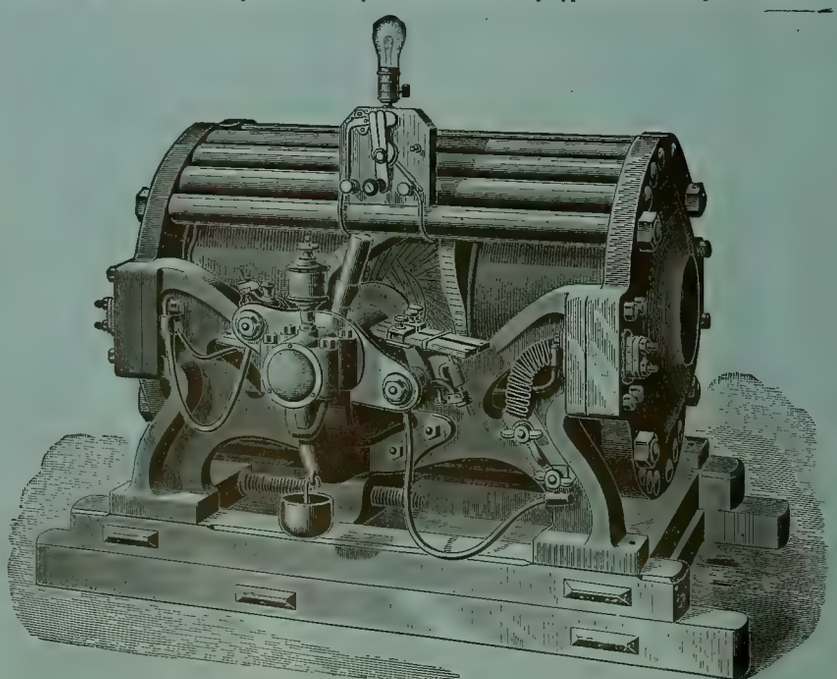
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS.

of all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

Edison's New Lamp

RESULT OF

EXPERT TEST

BY ELECTRICIAN OF

Chicago & Northwestern R. R.

Over 2000 Hours Average Life and 12.18 16 candle power lamps per horse power.

CHICAGO & NORTHWESTERN RY. CO., TELEGRAPH DEPT.
G. H. THAYER, Sup't.

CHICAGO, March 13, 1888.

LEONARD & IZARD, Chicago.,

Dear Sirs:—Regarding the Electric Light Plant at Clinton, Iowa, installed by you for this Company last December, I wish to say that your guarantee of 12 sixteen candle power lamps per horse power and 600 hours average life has been more than realized. The result, from careful tests, shows 12.18 sixteen candle power lamps per available horse power, and the record up to date shows an average life of over 2000 hours.

The pressure over the entire system does not vary over two volts, and the insulation with everything connected exceeds 100,000 ohms.

The dynamo works without sparking, and the whole plant is in every way satisfactory. Very respectfully,

(SIGNED) G. H. THAYER, Supt. Telegraph.

Plant Installed by LEONARD & IZARD, General Agents Edison United Manufacturing Co.,

185 DEARBORN STREET, CHICAGO.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{50}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager. 219 LA SALLE ST., CHICAGO.

Edison vs. The United States Electric Lighting Co.

This ad. occupies the same space occupied last week, and preceding weeks, by the Edison Company who stated that "THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF THOMAS ALVA EDISON, WHICH PATENTS ABSOLUTELY CONTROL," etc., etc. Upon another page of last week's issue of this Journal, issued after the United States Court's decision that in substance rendered THOMAS ALVA EDISON'S PATENTS ABSOLUTELY WORTHLESS, we notice the Edison Company only advertise themselves as "MANUFACTURERS and CONTRACTORS," etc., etc. *"What a fall was there my countrymen!"*

Before EDISON WAS BEATEN AT LAW and THE U. S. E. L. CO. became THE VICTORS, the Edison people went to the extreme length of saying that "the courts will soon render a decision which will knock the bottom clean out of the U. S. E. L. Co. and give Edison an absolute monopoly to incandescent lighting, and be a virtual extinction of the U. S. E. L. Co." Now after being beaten they will probably say "Oh this decision is not of much account anyway, you will hear from Edison again."

WHY NOT write to the Edison Electric Light Co. for their "Pamphlet on the Five Heads, PATENTS, INVESTMENT, FUTILITY of GUARANTEES, DANGER and MORAL," which in light of the present U. S. Court decision should read INVALID PATENTS, BAD INVESTMENT, FUTILITY OF EDISON GUARANTEES, DANGER AND MORAL.

The famous Red Book entitled "A WARNING FROM THE EDISON ELECTRIC LIGHT CO." (i. e. Fire Cracker) will now be laid upon the shelf alongside of other Ancient History,

THE VICTOR'S Chicago Address is,

THE UNITED STATES ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager Western Department. *THE ROOKERY CHICAGO, ILLINOIS.*

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

JARVIS ENGINEERING COMPANY,

61 OLIVER ST. BOSTON. | 81 LAKE ST., CHICAGO. | 109 LIBERTY ST. NEW YORK.

H. A. CLASIER, Manager Western Dept.

CONTRACTING ENGINEERS FOR ERECTING COMPLETE STEAM PLANTS FOR

Electric Light and Power Stations

NATIONAL FEED WATER HEATER,
JARVIS BOILER SETTING, to burn Anthracite Coal and Coke Screenings
NATIONAL ROCKING and SHEFFIELD GRATE BARS.

SEND FOR NEW CATALOGUE.

THE STANDARD CARBON CO.,

SUCCESSORS TO THE

Boulton, Cleveland, and Crystal Carbon Companies.

CLEVELAND, OHIO.

C F ANNETT, President. S. F. FENTON, Vice-Pres. and Treas. CHAS. S. SMITH, Secretary.

THE UNITED ELECTRIC COMPANY,

SALT LAKE CITY, UTAH.

DEALERS IN

ELECTRICAL APPARATUS AND SUPPLIES,

Hotel and House Annunciators, Electric Gas Lighting, Fire and Burglar Alarms, Electro-Medical Apparatus, Telegraph Instruments, Wire and Batteries.

ESTIMATES FOR ELECTRIC LIGHTING GIVEN ON APPLICATION

POND ENGINEERING CO.

ENGINEERS AND CONTRACTORS.

Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

Agents for Armington & Sims' Engines, Steel Boilers, Jarvis' Furnace, Standard Rocking and Sheffield Grates, Lowe Feed Water Heater, Blake Pumps, Korting Injector, Etc.

CORRESPONDENCE SOLICITED.

707 and 709 MARKET STREET, - ST. LOUIS.

Branch, Room 31 Water Works Building, 600 Walnut St., Kansas City, Mo.

Sawyer-Man Electric Co.

LICENSEES OF THE

CONSOLIDATED ELECTRIC LIGHT COMPANY,

OWNERS OF THE SAWYER-MAN PATENTS.

GENERAL OFFICES:
MUTUAL LIFE BLDG.
32 NASSAU ST.,
NEW YORK

Plans and Estimates Furnished for all kinds of Incandescent Lighting.

Philadelphia Office:
No. 308 WALNUT ST

BOSTON OFFICE:
No. 33 FEDERAL ST.

Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

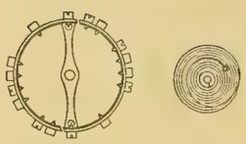
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

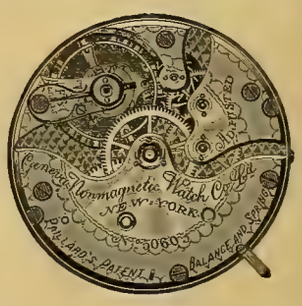
WHICH ARE

Uninfluenced BY **Magnetism.**



PAILLARD'S PATENT NON-MAGNETIC COMPENSATION BALANCE AND HAIR SPRING.

Adjusted TO **Temperature.**



These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

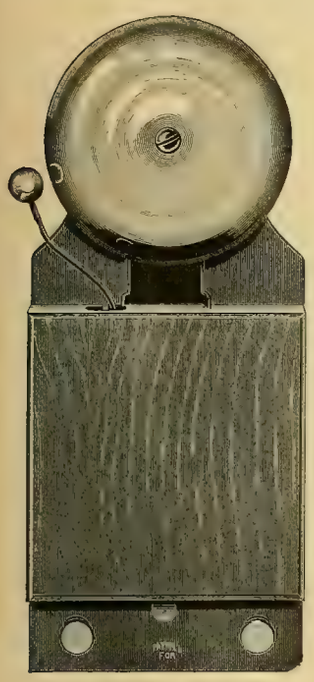
ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

FOR SALE BY ALL FIRST-CLASS JEWELERS.

ELECTRICAL DEPARTMENT

NEW HAVEN CLOCK CO.



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FOR

Bells,

Batteries,

Battery

Material,

BURGLAR ALARMS,

ANNUNCIATORS, PUSH BUTTONS,

Wires, Cables, Messenger Boxes,

ALL DISTRICT MESSENGER SUPPLIES, ETC., ETC.

We carry a Complete Stock of everything needed in the Construction and Operation of Telegraph, Telephone and Electric Lines of every description. Everything new and clean at bottom prices. Write for Catalogue and Quotations.

315-321 WABASH AVE., CHICAGO.

NEW YORK. BOSTON. SAN FRANCISCO.
LONDON. LIVERPOOL.

G. A. HARMOUNT, WESTERN AGENT.

AMERICAN SYSTEM

OF

ELECTRIC LIGHTING.

(WOOD'S PATENTS), Owned and Manufactured by the

American Electric Manufacturing Company,

18 CORTLANDT STREET, NEW YORK.

For simplicity of construction, steadiness and purity of light, perfection of Automatic regulation, economy of power in operation, freedom from getting out of order, and absolute safety of Armatures from burning,

The AMERICAN DYNAMO HAS NO EQUAL.

INTENDING PURCHASERS, whether for Isolated Plants or Central Station use, desiring to investigate the merits of the AMERICAN SYSTEM, are requested to write to any of our customers.

OUR PATRONS ARE OUR FRIENDS AND SPONSORS.

FOR FURTHER PARTICULARS, ADDRESS

AMERICAN ELECTRIC MANUFACTURING CO.,

18 Cortlandt Street, NEW YORK.

The Edison Direct System of Central Station ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

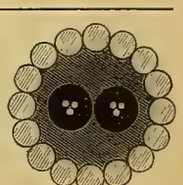
PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,

16 & 18 BROAD STREET, NEW YORK.

High Insulation



In order to meet the constantly increasing demands for

BETTER INSULATION,

THE BISHOP GUTTA-PERCHA CO.

420-426 EAST 25th STREET, NEW YORK CITY,

HAS EMPLOYED THE BEST EXPERTS TO BE HAD AND BUILT

NEW SPECIAL MACHINERY

FOR MAKING THE CELEBRATED

HOOPER'S CORE

AND OTHER RUBBER COMPOUNDS

FOR INSULATING WIRES FOR

Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading-in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

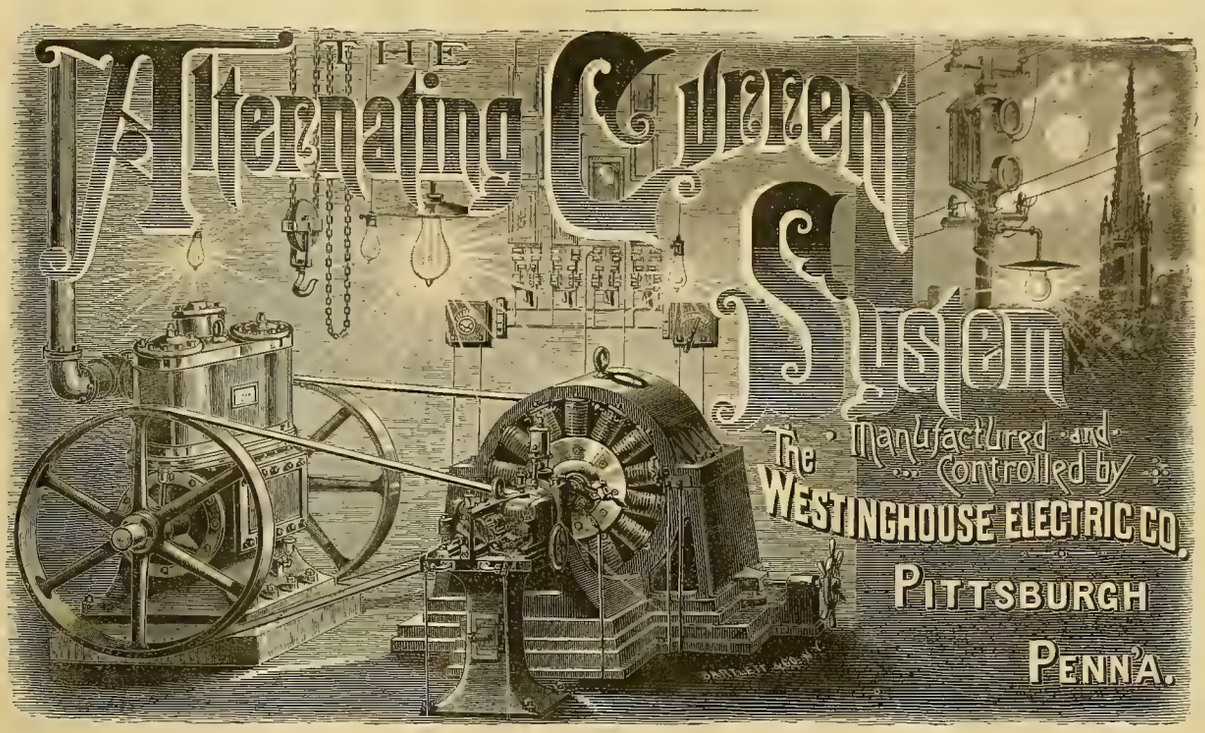
HENRY A. REED, Manager.

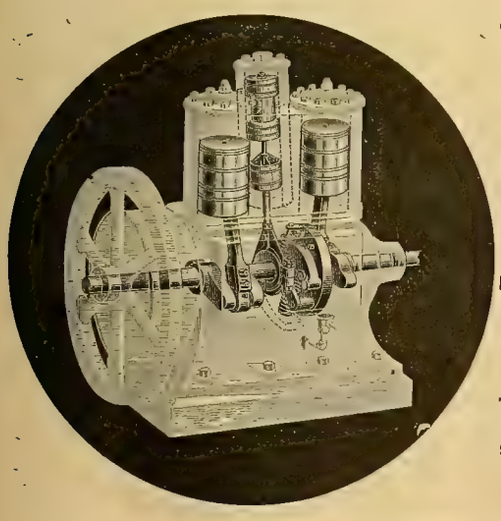
Use Marks' Compound Wire for Battery Coppers.

Use Balata Insulation for Flexible Cords.

USE NOTHING BUT

GUTTA-PERCHA FOR SUBMARINE CABLES.





The Single-Acting and Self-Lubricating Principles

Mark the second great advance in Steam Engineering, and represent the Highest type of

COMMERCIAL ECONOMY.

THE WESTINGHOUSE MACHINE CO.,
Pittsburgh, Pa.

THE AULTMAN & TAYLOR CO.,
Represented by ROBERTO BOKER & Co., City of Mexico, Mex.

Stevens, Corwin & Co., 118 Chambers St., New York City.
With houses in Panama, C. A., Lima, Buenos Ayres, Guayaquil and Valparaiso, S. A.

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WESTINGHOUSE, CHURCH, KERR & CO.
17 Cortlandt Street, New York. 97 Fifth Avenue, Pittsburgh.
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MIDLAND ELECTRIC CO.,

OMAHA, NEBRASKA.

——DEALERS IN——

ELECTRICAL SUPPLIES

For the Telegraph, Telephone and Electric Light.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learners' Instruments, Medical Batteries, Linemen's Tools, Bell Hangers' Supplies, Railway Velocipedes, Cars, Etc.

WESTERN AGENTS THE OKONITE CO., and the Return Call System of Hotel Annunciators. Fire Alarms for Cities and Towns. We own the Franchises of the Western States and Territories for the

IMPROVED McCULLOH

→*AMERICAN + DISTRICT + TELEGRAPH + SYSTEM,*←

and are prepared to give franchises and construct plants on reasonable terms.

☞Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

The Empire City Electric Co.

15 DEY STREET,

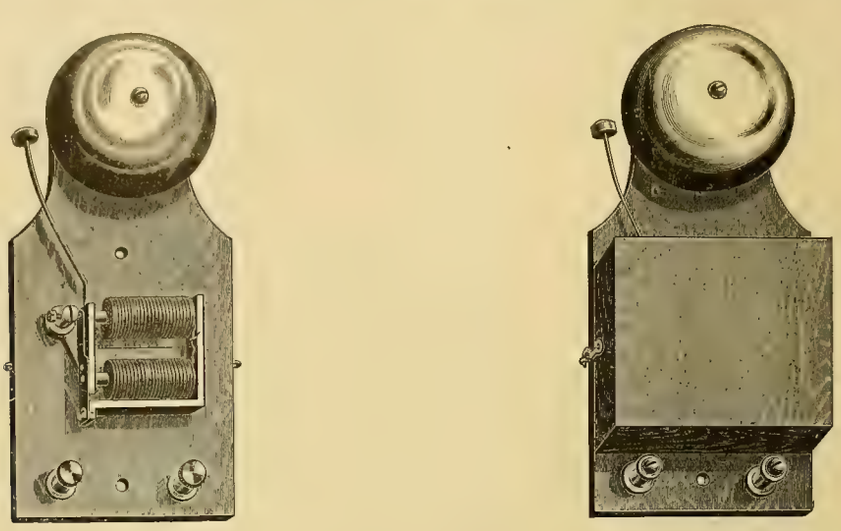
NEW YORK,

Manufacturers and Dealers

IN ALL KINDS OF

ELECTRICAL SUPPLIES.

ELECTRIC BELLS



THE ABOVE CUTS REPRESENT THE

Western Electric Walnut Box Bell.

The workmanship and finish being up to our usual standard is a guarantee that it is the best Bell for the money now upon the market.

EACH BELL PACKED IN NEAT PASTE BOARD BOX.

DIMENSIONS.

Back,	7 x 3 1-8 in.
Box,	3 1-8 x 2 13-16 x 1 1-5 in.
Resistance,	3 to 4 ohms.

We will send a sample Bell to any part of the United States by mail, postage prepaid, on receipt of seventy-five cents.

SPECIAL PRICES ON QUANTITIES FURNISHED ON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, JUNE 9, 1888. No. 23.

The Stoddard Cut-out.

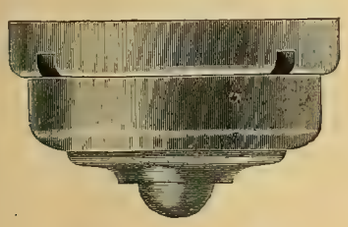
An illustration is given herewith of the Stoddard fusible cut-out, handled by the Central Electric company of Chicago. This cut-out is very simple and at the same time very effective. Its principal use is with lamp cords. A half turn of the top gives access to the connections of the interior for the circuit, while connection with the flexible cord is made through a slot in the bottom of the cut-out. In case the current becomes too heavy on the circuit, the metal within fuses and cuts out the cord and lamp, thus preserving them intact. The cut-out possesses the merit of being ornamental in addition to all its other advantages.

Whipple's Conduit for Electric Railways.

The accompanying cuts illustrate a conduit for electric railways, designed by S. Arca Whipple, of Detroit, Mich.

Fig. 1 is a vertical central cross-section showing the construction of the permanent way, and the construction and arrangement of the fixed and traveling conductors. Fig. 2 is a similar cross-section, on a smaller scale, showing the relation of the permanent way to the track and road bed. The letter *A* represents a railway cross-tie, near the ends of which are supported the longitudinal string *B*, upon which the rails *C* are secured and supported in the usual manner of building railway tracks.

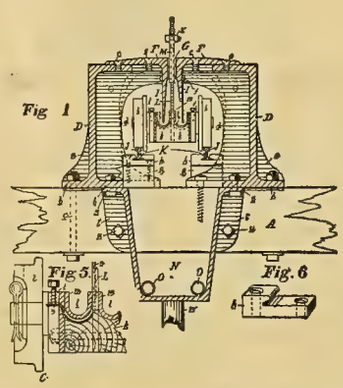
The conduit is located midway between the rails, and its object is to receive and protect the electrical conductors, both stationary and traveling, and permit readily of conveying the currents of electricity to the motor of an electric car to which the traveling conductor is secured and carried along with it in the usual manner. To this end the conduit consists of the side sections *D*, preferably made of cast iron and of a length equal to the distance from sleeper to sleeper. They are provided on the exterior with strengthening ribs *a* and with flanges *b* upon their ends, by means of which the sections are supported upon the sleepers, and secured thereto by means



The Stoddard Cut-out.

of bolts *c*, passing through said sleepers. Upon the interior the sections are provided with inwardly projecting ribs *d* at suitable distances apart to strengthen the sections sufficiently to sustain the weight of loaded vehicles which may pass over the top, and the sections are cut away on the inner ends upon curved lines, to permit the traveling conductors to pass freely through the entire length of the conduit. These sections are secured in pairs upon the sleepers at a certain distance apart, so as to leave in the center (on top) a slit or opening, *E*, the entire length of the conduit, and this slit is further cut away on the top, between the ends of each section, to permit the removal of the traveling conductor from the conduit, after the cover is removed. This covering *F* is also made in sections of the same length as the sections *D*, and is secured on the top thereof by means of suitable screws, *e*, so as to form a continuous slit, *G*, in the center the entire length of the conduit, and through which the connections between the traveling conductor and the car leave the conduit.

To the under side of the covering-sections *F* are secured the dependent flanges *I*, which project some distance downwardly into the interior of the conduit for the purpose as hereinafter described. If desired, these dependent flanges may be made integral with or supported from the cover-sections—for instance, by forming lugs *f* upon the interior ribs, *d*, as shown in Fig. 1, from which these dependent flanges may be detachably suspended.



Whipple's Conduit for Electric Railways.,

The stationary electrical conductor is formed by securing upon the cross-ties within the interior of the conduit longitudinal sleepers or blocks *g*, which are preferably of wood and creosoted or otherwise rendered durable, and upon this the insulating chairs *h* are secured, which support the metallic rails *J*. These insulating chairs *h* are preferably of glass.

The traveling conductor is in the form of a four-wheel metallic truck, of which *i* are the wheels, *j* are the metallic sides of the body, and *k* is a central insulated body secured between the sides of the truck, preferably of wood, rendered durable by creosoting or otherwise. On the top of this insulating body are formed longitudinal gutters *l*, which extend the entire length thereof to collect the water and permit it to run off the car. These gutters are lined with insulating material impervious to water or moisture, to protect the body of the car from becoming wet and losing its insulating quality, and this insulating material is also preferably placed between the metallic sides and the insulating body of the traveler.

In the center of the body and projecting upwardly therefrom is secured a metallic standard, *L*, which projects out through the top of the conduit, and is vertically slotted to receive the conducting wires *n*, which branch off laterally at the bottom of that standard and laterally connect with the metallic sides of the traveler, respectively, so that one wire forms the supply conductor and the other the return conductor from the motor.

The thirty-third anniversary of the establishment of the first telegraph line in Spain was recently celebrated by banquets at nearly all the principal towns, excepting Madrid. At Barcelona the director of telegraphs in that town presided at a dinner, during which M. Saavedra gave a very interesting historical sketch of the progress of the telegraph in Spain.

Bell Against Cushman.

The suit of the American Bell Telephone company and the Chicago Telephone company against the American Cushman Telephone company and others was before Judge Blodgett in the United States Court in Chicago June 1st. He decided at that time to hear the arguments on the following Monday. The counsel for the Bell company were George L. Roberts of Boston; Chauncey Smith, Boston; Benjamin F. Thurston, Providence, and E. H. West, of West & Bond, Chicago. Judge C. D. F. Smith and James L. High represented the defendants.

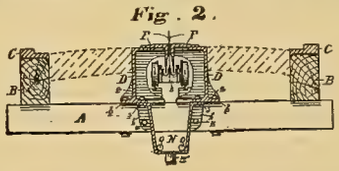
The suit is that in which the Bell company seeks to restrain the defendants from manufacturing and using telephones which are alleged to infringe on patents 174,465 and 186,787, granted to Professor Bell in 1876 for electric speaking telephones.

Dr. Cushman, it will be remembered, alleges that he discovered the principles of the telephone in 1851, while constructing a telegraph line near Racine. He claims that he used the instrument for the purpose of conveying speech. He came to the conclusion that the "talking box" was of no practical value and did not endeavor to develop it. He claims that he carried the instrument up to the point where a transmitter was needed and then he left it.

The opening argument for the Bell company was made Monday by George L. Roberts. Before the case was opened, Judge Blodgett, to quote his own words, said the whole subject was *terra incognita* to him. He had never used a telephone. He had never seen one except as he had noticed a box as he passed through a room. Consequently he needed instruction concerning the telephone from the counsel.

Mr. Roberts faithfully responded to the call of the court. He commenced at the beginning and explained at length the accepted theory of sound, and then in detail described the telephone and its applications. He followed with a discussion of the voluminous mass of testimony which had been taken in the case. He discredited Dr. Cushman's testimony, as to the story of the discovery

Fig. 2.



Whipple's Conduit for Electric Railways.

of the principle of the telephone. Experiments had demonstrated that the sound of the bullfrogs could not have been heard, as Dr. Cushman had stated, by means of the lightning arrester telephone. He referred to the statement of a witness that Dr. Cushman had experimented with one of the instruments in a cellar in Racine, and said it had been proved conclusively that no such cellar existed, as the house was without this convenience. Mr. Roberts said the testimony relative to the early experiments with the alleged telephone, soon after 1851, was confined to the Cushman family, and that the matter was for the most part a family affair. The stories as to the uses of the telephone, Mr. Roberts treated as myths. The idea that instruments, such as the defendant described as having been in use over a six-mile circuit, was, he thought, absurd in the extreme. There had been no means for signaling between the telephones, and this fact alone, he considered, threw great doubt on the testi-

mony that the instruments had been constantly employed in sending messages. The fact, however, was that the instruments were of little or no value. Telephones, identical with those which it was testified had been used on this six-mile circuit had been carefully tested, and it was found utterly impossible under favorable conditions to carry on a conversation by their use. Mr. Roberts held that those who had claimed to have seen the Cushman instruments in 1851 and 1867 were either mistaken or had wilfully committed perjury. Speaking of the occurrence at the latter date, Mr. Roberts said, "The court is asked to believe that in 1867 and 1868 Cushman publicly exhibited the same electrical apparatus in Ohio, and fully explained the method of its operation for the transmission of articulate speech, and that, nevertheless, this wonderful announcement that speech could be transmitted electrically, accompanied by explanations of how it was done, and by the exhibition of apparatus for doing it, although repeated in several places, was not even mentioned by the local newspapers, which are commonly quite eager to publish novel items. The fact of the case is that nobody ever heard of Cushman's claim until after the patent was secured by Bell. Then Cushman used his alleged invention to secure a position with the Bell company, which he held at $180 per month for three years until 1885."

Mr. Roberts carefully analyzed the testimony, aiming to show that Dr. Cushman's testimony was full of inconsistencies, and that his actions at times were utterly at variance with the theory that he had discovered the principle of anything but an acoustic telephone.

Judge C. D. F. Smith followed with an argument for the defense.

Dental Electrics.[1]

By C. Edmund Kells, jr., D. D. S.

The subject of electricity is to-day occupying the minds of thousands, its wonderful advances

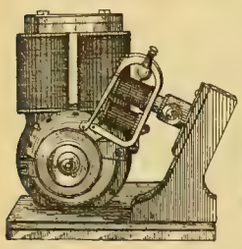


Fig. 2.

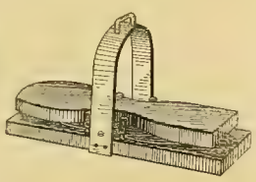


Fig. 3.

within the past ten years having, assuredly, no equal in any of the other sciences or arts. Turn in almost any direction we will, we are met by this subtle agent rendering some service to man. To note its progress we have but to recall the Philadelphia centennial exhibition of 1876, when there was neither telephone, electric light nor electric motor—speaking from a practical and commercial point of view—and compare it with the present, when there are hundreds of electric stations supplying myriads of lamps and countless motors.

To the dentist "time is money," and so it is that all means of shortening any process, lessening the labor, or saving pain, are eagerly sought for and quickly adopted. For accomplishing these ends there can be no doubt that the electric current is the agent from which the best results are to be derived, and how this may be done is the subject of this paper.

Before going into details, we must admit that until comparatively recently the battery question was a great drawback to the general use of electricity in dental offices. Now, however, that electric light and power stations are being installed so rapidly it will not be long before the dentist, even in the smaller cities, will be supplied with a constant current at low cost and no trouble.

One of the greatest difficulties encountered by those commencing to "read up" upon this subject is caused by the great number of new and confusing terms used. It will be my endeavor to be as explicit as possible, and to adhere to old English, wherever practicable. It must be borne in mind that the electric current may vary in force, as does any other power; and instruments that are designed for a current of a certain strength will not operate well, or at all, with one of a lesser; or will be destroyed by one too great, for example: An electric mallet designed to be operated by a battery of four cells will not run on a current derived from a single cell, and will soon be destroyed if connected directly to the electric light wires, carrying their powerful current. Therefore, it becomes necessary to first learn the character of the current with which we are to be supplied, then the capacity or require-

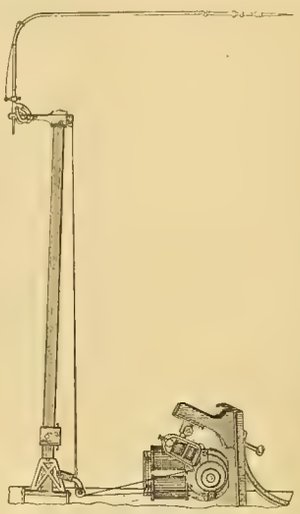


Fig. 1.

ments of the instruments we are to use, when means for combining the two may be devised. Using the well-known Edison current, supplied from the station plant, one-fourth of a mile distant, the apparatus herein described is proportioned to its particular strength, and would, therefore, need slight modifications to be suited to any other.

The selection of a motor is naturally the first question. There being a great variety of these upon the market, no one can assert without having made comparative tests of them all which is the best. The main point to be considered is that of power; if that be sufficient the details of arrangements of the various parts and general style of the motor are immaterial. But it is necessary that under all circumstances there be plenty of motive force, and that the cutting instrument or the grinding wheel is capable of performing its work, otherwise the apparatus is nothing more than a toy, which may be said of some I have seen. The one I use, and which is perfectly satisfactory in every respect, is a handsome little one of one-eighth horse power, made by the "C. & C." company, of New York. For over a year it has done its work with no attention, save daily oiling. This motor, or in fact any other, not being well adapted to run the movable S. S. W. engine, a "suspension" was tried, but from its inherent faults proved unsatisfactory. Therefore, a new form was devised,

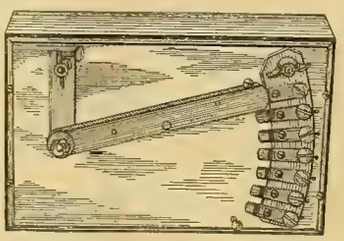


Fig. 4.

containing all the advantages of the suspension, with none of its disadvantages. Fig. 1 shows the engine, which consists of the S. S. W. pulley-head and arm, mounted on a light swinging bracket. This being pivoted to the wall in front of the chair, allows the pulley-head to swing horizontally into any position desired, and at once gives the most perfect freedom to, and command of the hand-piece. The pulley head by means of a groove in its supporting rod, and a screw in its socket, is allowed to make but a half horizontal revolution, that the driving band be not interfered with. Below the swinging arm, the motor is placed, supported on a little shelf, and connected to the engine by an ordinary band, as shown. The little apparatus, shown partly to the right and in front of the motor, is the *brake*, which is the important feature of this installation, as by it the engine may be stopped at once. In Fig. 2 it is shown a little larger, by which it is seen to consist of a clutch operated by an electro-magnet, a simple and exceedingly effective device. When the electric current goes to the motor the engine band slips freely through this clutch, but when the current is changed to the magnet of the brake, the band is gripped, stopped instantly, while the momentum of the motor may continue to revolve the wheel for several seconds.

This completes our engine; now for its control, for if we want perfection, we must be able to start and stop it instantly while in any position at the chair. Fig. 3 shows the apparatus devised for this purpose, to be operated and moved by the foot. Being connected by flexible wires, it allows the operator to take any position on either side of the chair, and with the greatest ease have the most absolute control of his cutting instrument. When in position as shown, the rocking foot-piece is held horizontally by springs, and the motor does not run. Placing the foot upon the pedal and pressing upon the heel brings two electric terminals together, and the engine runs as long as it is held there. Pressure on the toe, changes the current to another set of contacts, thereby diverting it from the motor to the electro-magnetic brake, stopping the burr instantly, as before shown. An automatic lock was at first used to hold the pedal in either position, but not being an advantage, has been taken off. Thus it is seen that

Fig. 5.

by the rocking of the foot. the engine is started or stopped at will, and may be governed by either foot, and in any position.

Having disposed of the questions of starting and stopping the engine, we now turn naturally to that of grading its speed, for that is also a necessity. Right here it will be well to dwell a little

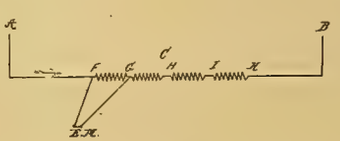


Fig. 6.

upon certain characteristics of the electric current, that we may understand the apparatus needed for this purpose. By conductivity we refer to that inherent property of all matter by which the passage of electricity is effected. By resistance is meant that inherent property possessed also by all substances whereby the passage of the current is opposed. Both of these properties are found in all substances, varying in degree only. If our motor were connected directly to the Edison wires, a certain speed, far in excess of what we need, would be attained. But if we intercept this current and make it do more work before it reaches the motor, which may be done by passing it through a body of a certain resistance, we naturally reduce its speed, and by varying this resistance, we correspondingly vary the speed of the engine. This is readily accomplished by a switch connecting several coils of wires, each of which adds to the resistance, and so a graded set of speeds is obtained. The coils being placed in a box and the switch arranged upon the cover, as shown in Fig. 4, constitutes an apparatus called a shunt which should be placed, if possible, upon the wall within easy reach of the operator while standing at the chair. The speed is varied by swinging the lever up or down. This is furnished with the motor by its makers.

To refer again to the properties of this most wonderful current, I will cite the ordinary incandescent lamp as an example of the fact that when a given current passes through a body of a certain resistance, the latter becomes heated. Here the carbon filament becomes white hot by that

[1] From *The Dental Review*.

process. We may take advantage of this phenomenon in the following manner: A small pressure blower, driven by the motor, is made to force a jet of air through a rubber tube carried on the engine bracket, and down the cable sheath. Just before reaching the hand-piece it ends in a little glass tube in which is a fine coil of platinum wire, wound upon an asbestos core. From this it is continued again to the end of the hand-piece, where it terminates in a little nozzle. Through the wire within the glass tube is passed the current that drives the motor, and it is so proportioned as to length and thickness as to become heated thereby. The air passing over it

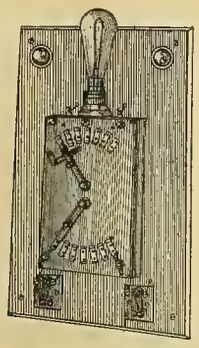


Fig. 7.

becomes warm, so when forced in a gentle blast into the cavity being prepared, it keeps it painlessly free from chips. By means of a loose pulley the blower is run or stopped at will, and when not in use a switch cuts out the current from the platinum coil.

Were we to connect our electric mallet directly to the Edison wire, being constructed for a much lighter current, it would soon be destroyed, as before stated. If we connect it to the shunt already described, the current can be made sufficiently weak to do it no harm, but at the same time there are certain objections to the use of it in this manner. An explanation of this fact would occupy much time and lead us into deep water of electrical science, so it will probably be wiser to merely show a better method of reducing the current for that purpose, without remarks. Fig. 5 shows how the coils of wire are connected in the shunt with which to govern the speed of the motor, in which the current flows from *A* through the coils *C* to the motor at *M*, and on to *B*, the motor being in the direct track of the current. The lever is arranged to cut out, that is, throw out of the circuit more or less of these coils, whereby the variation of speed is accomplished. Now, the mallet must be connected in the manner shown in Fig. 6, from which method a very different result is obtained:

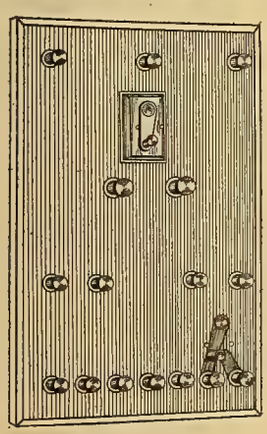


Fig. 8.

One wire from the mallet *EM* is connected directly to the main line, at *F*. If then we connect the other wire to the coils, at *G*, it will be seen that the current can branch at *F*, a portion going directly through the coil *FG*, and another portion flowing through the mallet, operating it at a certain speed and force of blow. Changing the wire from *G* to *H*, *I* or *K* alters the relative proportion of the coils, and at each point a particular character of blow is given by the mallet. Knowing the law that governs the case, it is possible to make this apparatus up in the same style as the shunt for the motor, and by the simple moving of the lever, grade the blow within any necessary limit. By these two shunts, any of the electrical instruments furnished us, such as the mouth lamp, cautery, etc, may be operated by the Edison current.

Instead of using two separate ones, as described, each with its coils connected in the manner indicated, it is possible to use one set of resistances only, connecting them in the two methods needed, each of which acts independently of the other. Such a one as I am now using is shown in Fig. 7. The upper switch governs the mallet, the lower one the motor. It happens that an ordinary electric lamp presents as much resistance as a great many feet of wire that can be safely used with this current. Taking advantage of that fact, one is used for the purpose of taking the place of a certain number of coils, as shown in the cut.

By leading the wires from these terminals, to a switch-board, shown in Fig. 8, placed upon the wall over the engine, as shown in Fig. 9, any and all the various instruments may be then readily connected or disconnected. To each set of binding posts its special current is brought, and the switches, as shown, allow the currents to be turned on or off at will.

The special arrangement of different offices not being the same, the positions of the apparatus must be altered to suit individual cases, but the general plan will hold good. Fig. 9 shows the system as in use in my own office, as well as a cut can do. Upon the cabinet are seen the electric mallet and mouth lamp, also a small electric lamp mounted upon a movable stand, and placed within a reflector. Here is also placed the foot-piece which governs the motor and brake, properly connected by its flexible wires, it being put here for the occasion, for were it down upon the floor in its usual position, it would be out of the range of vision. All these are connected to the switch-board, as are also the motor and brake. But the mallet and the two lamps never being connected except when in use, and the three never at the same time, the superfluity of wires here presented is for this occasion only.

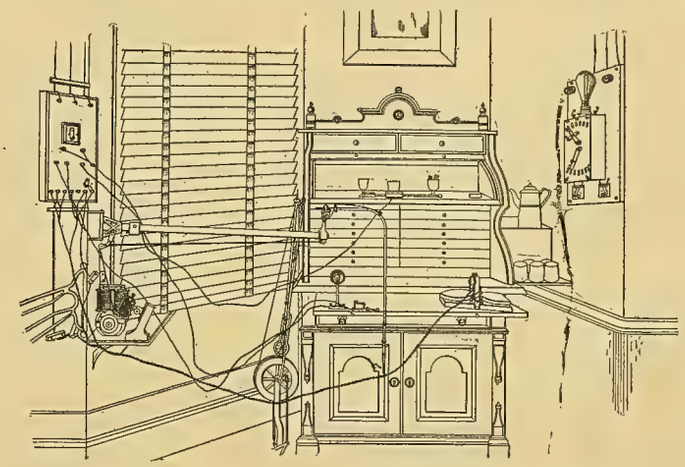


Fig. 9.

During the summer—six or seven months in this climate—another motor of same make drives a fan, and as a matter of interest, to slow it down to the proper speed, a lamp is used as a resistance, instead of wires. This is immersed in a little jar of water, which it keeps just the right degree of warmth for use in the syringe. Thus the same agent that is used to keep our office cool and our patients and ourselves comfortable, is also employed to heat the water for their use, and so adds to their comfort in that way. This motor and lamp are connected by flexible wires, each to one of the sockets shown on either side of the lamp in Fig. 7, and are governed by the two little switches shown below the shunt box.

It will then be seen that from the two insignificant little wires that enter our office are derived heat and cold, light and power, and a world of pleasure and comfort and profit. Could we ask for more from one source?

Here where it will occasion no confusion let me say that by comparing electrical measurements to those of hydraulics, a very good idea of them may be readily obtained. In the latter the pressure is given in pounds, the quantity in gallons, and friction is always taken into account in rating the discharging capacity of a pipe of a certain length and diameter. So in electricity—the pressure is recorded in volts, the quantity in amperes, and the friction or resistance in ohms. Therefore when we read of a current of so many volts we know its tension or pressure is referred to; when amperes appear, quantity is spoken of; and ohms refer always to the resistance encountered. The current dealt with in this article is of about 110 volts; resistance in series referring to the method of connection of coils as shown in Fig. 5, 100 ohms; resistance of five coils of German silver insulated wire number 18, in shunt—technical name of method shown in Fig. 6—with upper switch of Fig. 7 shunt, 40 ohms; resistance of lamp there shown, 108 ohms.

From the drawings and data given, any practical electrician can duplicate any apparatus herein described, and is free to do so, for, while this system is original with me, and is the first instance of which I can learn that a current from a central electric light and power station has been utilized for running a dental mallet, etc., no parts are or will be patented; the pleasure I am deriving from their use myself, and from seeing them in general use, which I expect to see within the next few years, amply repays me for the many, very many hours spent in their devising.

Fires from Electric Wires.

At a meeting of the Society of Telegraph Engineers and Electricians W. H. Preece read a paper on "The risks of fire incidental to electric lighting." A considerable part of the paper was devoted to consideration of fire rules.

He pointed out that, in the interest of electric lighting, it was important to prevent such alarms of fire as occurred—for example, in Lord Brassey's house, where a transformer which had recently been fixed in position in an iron fireproof case, heated the case, and gave rise to an alarm, though no fire actually occurred. He also instanced the fire occurring at the Temple theater at Boston, by which that theater was destroyed, and which originated in a short circuit in cotton-covered wires insulated by paraffine. He also mentioned a fire which occurred at the Midland works at Derby, due to a short circuit heating, and setting fire to one of the old wooden lamp holders. The author pointed out that while in 1887 the number of theaters destroyed by fires arising from the lighting system in use averaged about two a month, the total number of fires arising from the use of the electric light during the same period was, after all, exceedingly small. Many of the sources of danger in electric lighting were of a nature which had never been anticipated—for example, in stables, the corrosive action of the ammonia upon the metal staples, and in houses, short circuits, arising from washing floors and the ravages of rats and mice, were all sources of danger which had to be provided against. It was a common practice, but one which could not be too strongly deprecated, to bury electric conductors in cement when houses were being built. Moisture was a great source of danger. In underground work

water was a safeguard, as gutta-percha insulation is protected from decay when under water; but in the air both gutta-percha and india-rubber, when exposed to moisture and to changes of temperature, were very liable to deterioration. The wires were then attacked by electrolytic action until they became eaten away so much in some places as to be unable to carry the currents without undue heating. The practice of encasing wires in wood was an extremely dangerous one, and several fires in ships had arisen from this cause. Mercury contacts were most objectionable, except in positions where the mercury could be frequently renewed. Where the electric light was used in houses, the luxury and convenience of the light often led to additional lamps being placed on the original leads until the latter were unable to safely carry the current required, which led to their becoming heated, and forming a source of danger. The greatest danger of all arose, however, from bad joints.

The New Graphophone.

E. D. Easton, of the firm of Johns & Easton, stenographers of Washington, who is reporting the arguments in the Bell-Cushman litigation, brought with him to Chicago two graphophones which he uses continually in transcribing his notes. The instruments, which are manufactured by the American Graphophone company, of Washington, are the results of the labors of Dr. Chichester Bell and Prof. C. S. Tainter. It is said that they received important assistance from Prof. Alexander G. Bell. By the courtesy of G. J. Chambers, one of the stenographers engaged in the telephone case, a representative of the WESTERN ELECTRICIAN was given an opportunity of testing the graphophone. It is an exceedingly simple instrument, but strong and durable in its construction. The essential features are the recorder, the record cylinder and the reproducer. In its operation it resembles the Edison phonograph, but it is claimed that it is far less complex. It has few parts which can get out of order.

The appearance of the graphophone is not unlike an ordinary sewing machine. The motive power is applied in the same way, by a treadle, though it is probable that an electric motor will be used for the purpose, as very satisfactory results have been attained with the motor on machines to which it has been applied. The recorder is a conical mouthpiece twenty inches in length, at the end of which is a mica diaphragm a little over two inches in diameter. In the center of the plate is a steel point which cuts into the record cylinder. At one side of the point is arranged a bridge to prevent the point from cutting deeper than 1-500 part of an inch into the record cylinder. Attached to the diaphragm-holder is a clutch, to which is fastened a section of a nut which fits a horizontal screw six inches long, and cut with forty threads to the inch. The record works from right to left, and is carried along by the revolving screw. Beneath and in front of the screw is the lathe, on which is carried the record cylinder. This is a paper shell six inches in length and about one inch in diameter. Its outer surface is coated with a waxen compound called "oparite," and has the appearance of a highly polished piece of vulcanized rubber. The cylinder can be attached to the machine in the same manner as a spool to the reeling apparatus on a sewing machine. By a system of quadruplex gearing its velocity is four times greater than that of the horizontal screw, and hence the point on the diaphragm cuts on the cylinder a succession of threads numbering 160 to the inch. This thread, when there is no vibration of the diaphragm, is perfectly uniform. By speaking into the mouthpiece each thread becomes dotted to a greater or less intensity, according to the pitch of the voice.

The reproducer is on a much smaller scale than the recorder, and generally speaking resembles a stethoscope. Remove from that the sound receiver, and attach to it a mica diaphragm about an inch in diameter. Protruding from the centre is a rubber tube the thickness of a quill, and three inches long. At its extreme end is a little steel point which works on a pin, and which is attached by a silken fibre to the little diaphragm. This machine has also a section of nut threaded to fit the horizontal screw already mentioned, and likewise moves from right to left on the machine. The point fits the indentations made by the recorder and moves in sympathy with them. By means of the silk fibre the mica diaphragm is caused to vibrate, and the sound is reproduced in the ears by means of the stethoscope audiphones.

The tests which were made with the instruments demonstrated its capacity to reproduce speech with remarkable fidelity. When a person listens to the words for the first time, the novelty or the surprise attending the curious reproduction tends to confuse; but after the tubes have been in the ears for two or three minutes, he has not the slightest difficulty in distinguishing every sentence. Testimony in a telephone suit, which had been dictated in the recorder at the rate of about 200 words per minute, was understood perfectly. A German song which had been sung by a gentleman who possessed a robust voice was repeated with all the shading which had been given by the singer. An air from the "Mikado" was whistled and was repeated, and then for the sake of novelty, the air was reproduced backwards.

Mr. Easton uses six of the graphophones in Washington and finds them of the greatest service. He writes many of his letters by the steel point of the diaphragm, and sends the cylinders to his correspondents.

A New System of Alternate Current Motors and Transformers.[1]

By NIKOLA TESLA.

PART II.

The synchronism of these motors may be demonstrated experimentally in a variety of ways. For this purpose it is best to employ a motor consisting of a stationary field magnet and an armature arranged to rotate within the same, as indicated in Fig. 13. In this case the shifting of the poles of the armature produces a rotation of the latter in the opposite direction. It results therefrom that when the normal speed is reached the poles of the armature assume fixed positions relatively to the field magnet and the same is magnetized by induction, exhibiting a distinct pole on each of the pole pieces. If a piece of soft iron is approached to the field magnet it will at the start be attracted with a rapid vibrating motion produced by the reversals of polarity of the magnet, but as the speed of the armature increases the vibrations become less and less frequent and finally entirely cease. Then the iron is weakly but permanently attracted, showing that the synchronism is reached and the field magnet energized by induction.

The disk may also be used for the experiment. If held quite close to the armature it will turn as long as the speed of rotation of the poles exceeds that of the armature; but when the normal speed is reached, or very nearly so, it ceases to rotate and is permanently attracted.

A crude but illustrative experiment is made with an incandescent lamp. Placing the lamp in circuit with the continuous current generator, and in series with the magnet coil, rapid fluctuations are observed in the light in consequence of the induced currents set up in the coil at the start; the speed increasing, the fluctuations occur at longer intervals, until they entirely disappear, showing that the motor has attained its normal speed.

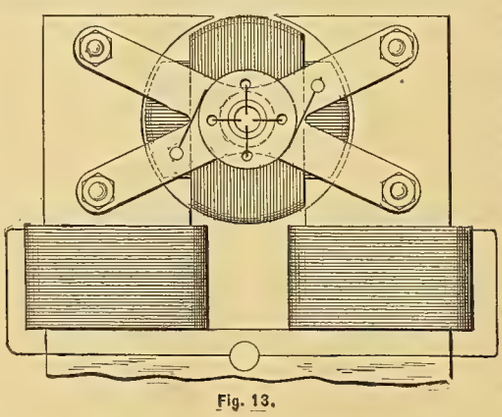


Fig. 13.

A telephone receiver affords a most sensitive instrument; when connected to any circuit in the motor the synchronism may be easily detected on the disappearance of the induced currents.

In motors of the synchronous type it is desirable to maintain the quantity of the shifting magnetism constant, especially if the magnets are not properly subdivided.

To obtain a rotary effort in these motors was the subject of long thought. In order to secure this result it was necessary to make such a disposition that while the poles of one element of the motor are shifted by the alternate currents of the source, the poles produced upon the other element should always be maintained in the proper relation to the former, irrespective of the speed of the motor. Such a condition exists in a continuous current motor; but in a synchronous motor, such as described, this condition is fulfilled only when the speed is normal.

The object has been attained by placing within the ring a properly subdivided cylindrical iron core wound with several independent coils closed upon themselves. Two coils at right angles are sufficient, but a greater number may be advantageously employed, as in Fig. 14. It results from this disposition that when the poles of the ring are shifted currents are generated in the closed armature coils. These currents are the most intense at or near the points of the greatest density of the lines of force, and their effect is to produce poles upon the armature at right angles to those of the ring, at least theoretically so; and since this action is entirely independent of the speed—that is, as far as the location of the poles is concerned—a continuous pull is exerted upon the periphery of the armature. In many respects these motors are similar to the continuous current motors. If load is put on, the speed, and also the resistance of the motor, is diminished and more current is made to pass through the energizing coils, thus increasing the effect. Upon the load being taken off, the counter-electromotive force increases and less current passes through the primary or energizing coils. Without any load the speed is very nearly equal to that of the shifting poles of the field magnet.

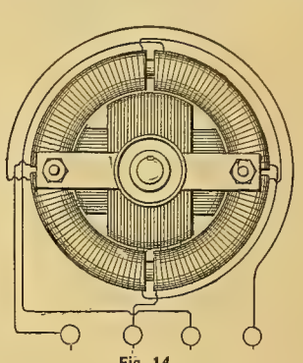


Fig. 14.

It will be found that the rotary effort in these motors fully equals that of the continuous current motors. The effort seems to be greatest when both armature and field magnet are without any projections; but as in such dispositions the field cannot be very concentrated, probably the best results will be obtained by leaving pole projections on one of the elements only. Generally, it may be stated that the projections diminish the torque and produce a tendency to synchronism.

A characteristic feature of motors of this kind is their capacity of being very rapidly reversed. This follows from the peculiar action of the motor. Suppose the armature to be rotating and the direction of rotation of the poles to be reversed. The apparatus then represents a dynamo machine, the power to drive this machine being the momentum stored up in the armature, and its speed being the sum of the speeds of the armature and the poles. If we now consider that the power to drive such a dynamo would be very nearly proportional to the third power of the speed, for this reason alone the armature should be quickly reversed. But simultaneously with the reversal another element is brought into action; namely, as the movement of the poles with respect to the armature is reversed, the motor acts like a transformer in which the resistance of the secondary circuit would be abnormally diminished by producing in this circuit an additional electromotive force. Owing to these causes the reversal is instantaneous.

If it is desirable to secure a constant speed, and at the same time a certain effort at the start, this result may be easily attained in a variety of ways. For instance, two armatures, one for torque and the other for synchronism, may be fastened on the same shaft, and any desired preponderance may be given to either one, or an armature may be wound for rotary effort, but a more or less pronounced tendency to synchronism may be given to it by properly constructing the iron core; and in many other ways.

As a means of obtaining the required phase of the currents in both the circuits, the disposition of the two coils at right angles is the simplest, securing the most uniform action; but the phase may be obtained in many other ways, varying with the machine employed. Any of the dynamos at present in use may be easily adapted for this purpose by making connections to proper points of the generating coils. In closed circuit armatures, such as used in the continuous current systems, it is best to make four derivations from equi-distant points or bars of the commutator, and to connect the same to four insulated sliding rings on the shaft. In this case each of the motor circuits is connected to two diametrically opposite bars of the commutator. In such a disposition the motor may also be operated at half the potential and on the three-wire plan, by connecting the motor circuits in the proper order to three of the contact rings.

In multipolar dynamo machines, such as use the converter systems, the phase is conveniently obtained by winding upon the armature two series of coils in such a manner that while the coils of one set or series are at their maximum production of current, the coils of the other will be at their neutral position, or nearly so, whereby both sets of coils may be subjected simultaneously or successively to the inducing action of the field magnets.

Generally the circuits in the motor will be similarly disposed and various arrangements may be made to fulfill the requirements; but the simplest and most practicable is to arrange primary circuits on stationary parts of the motor, thereby obviating, at least in certain forms, the employment of sliding contacts. In such a case the magnet coils are connected alternately in both the circuits; that is, 1, 3,

[1] Read before the American Institute of Electrical Engineers, May 16th.

5 in one, and 2, 4, 6 in the other, and the coils of each set of ser es may be connected, all in the same manner, or alternately in opposition; in the latter case a motor with half the number of poles will result and its action will correspondingly be modified.

The employment of multipolar motors secures in this system an advantage much desired and unattainable in the continuous current system, and that is, that a motor may be made to run exactly at a predetermined speed irrespective of imperfections in construction, of the load, and, within certain limits, of electromotive force and current strength.

In a general distribution system of this kind the following plan should be adopted: At the central station of supply, a generator should be provided having a considerable number of poles. The motors operated from this generator should be of the synchronous type, but possessing sufficient rotary effort to insure their starting. With the observance of proper rules of construction it may be admitted that the speed of each motor will be in some inverse proportion to its size, and the number of poles should be chosen accordingly. Still, exceptional demands may modify this rule. In view of this, it will be advantageous to provide each motor with a greater number of pole projections or coils, the number being preferably a multiple of two and three. By this means, by simply changing the connections of the coils, the motor may be adapted to any probable demands.

If the number of the poles in the motor is even the action will be harmonious and the proper result will be obtained; if this is not the case the best plan to be followed is to make a motor with a double number of poles and connect the same in the manner before indicated, so that half the number of poles result. Suppose, for instance, that the generator has twelve poles and it would be desired to obtain a speed equal $\frac{1}{7}$ of the speed of the generator. This would require a motor with seven pole projections or magnets, and such a motor could not be properly connected in the circuits unless fourteen armature coils would be provided, which would necessitate the employment of sliding contacts. To avoid this the motor should be provided with fourteen magnets and seven connected in each circuit, the magnets in each circuit alternating among themselves. The armature should have fourteen closed coils. The action of the motor will not be quite as perfect as in the case of an even number of poles, but the drawback will not be of a serious nature.

However the disadvantages resulting from this unsymmetrical form will be reduced in the same proportion as the number of poles is augmented.

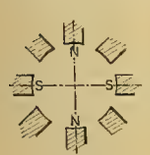


Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

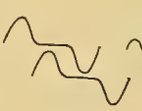


Fig. 19.

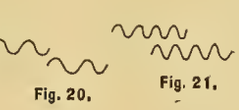


Fig. 20.

Fig. 21.

If the generator has, say, n, and the motor n_1 poles, the speed of the motor will be equal to that of the generator multiplied by $\frac{n}{n_1}$.

The speed of the motor will generally be dependent on the number of the poles, but there may be exceptions to this rule. The speed may be modified by the phase of the currents in the circuits or by the character of the current impulses or by intervals between each or between groups of impulses. Some of the possible cases are indicated in the diagrams, Figs. 18, 19, 20 and 21, which are self-explanatory. Fig. 18 represents the condition generally existing, and which secures the best result. In such a case, if the typical form of motor illustrated in Fig. 14 is employed, one complete wave in each circuit will produce one revolution of the motor. In Fig. 19 the same result will be effected by one wave in each circuit; in Fig. 20 by two, and in Fig. 21 by four waves.

By such means any desired speed may be attained; that is, at least within the limits of practical demands. This system possesses this advantage besides others, resulting from simplicity. At full loads the motors show an efficiency fully equal to that of the continuous current motors. The transformers present an additional advantage in their capability of operating motors. They are capable of similar modifications in construction, and will facilitate the introduction of motors and their adaptation to practical demands. Their efficiency should be higher than that of the present transformers, and I base my assertion on the following:

In a transformer as constructed at present we produce the currents in the secondary circuit by varying the strength of the primary or exciting currents. If we admit proportionality with respect to the iron core the inductive effect exerted upon the secondary coil will be proportional to the numerical sum of the variations in the strength of the exciting current per unit of time; whence it follows that for a given variation any prolongation of the primary current will result in a proportional loss. In order to obtain rapid variations in the strength of the current, essential to efficient induction, a great number of undulations are required and employed. From this various disadvantages result. These are, increased cost and diminished efficiency of the generator, more waste of energy in heating the cores and also dimished output of the transformer, since the core is not properly utilized, the reversals being too rapid. The inductive effect is also very small in certain phases, as will be apparent from a graphic representation, and there may be periods of inaction, if there are intervals between the succeeding current impulses or waves. In producing a shifting of the poles in the transformer, and thereby inducing currents, the induction is of the ideal character, being always maintained at its maximum action. It is also reasonable to assume that by a shifting of the poles less energy will be wasted than by reversals.

(*Concluded.*)

The Continuous Current vs. the Alternating Current.[1]

By George H. Bliss.

I may as well admit myself at the outset to be ignorant from personal experience in regard to the alternating current as applied to electric lighting, and confess to never having seen such a plant or station in operation. My early impressions of the alternating system from personal and published statements were very favorable, and I was highly gratified that a practicable method had probably been discovered for the economical distribution of electrical energy over greatly extended areas. There was something quite pleasant in contemplating this development. This country had given to the world a practical method of electric incandescent lighting, and it seemed only fair reciprocity for Europe to return the compliment by an alternating system which should greatly enlarge the sphere of the electric light industry. In looking forward to this discussion, which was to be largely educational to me, I anticipated that the friends of the able imitators of the alternating system who have made such substantial progress with its introduction in this country, would bring forward conclusive arguments for its general adoption. I have been disappointed in this respect, and there is a growing conviction in my mind that the compressed air, which made the monied foundation for much of the support of the alternating current, has in some way or other found vent in altogether too windy and extravagant claims for that method of electrical distribution. No doubt the intimation will be repeated that I am closely allied to the parties controlling the leading constant current system of incandescent lighting, but such is not the fact. I am not connected nor in any way authorized to speak for that system. The representatives of that interest who are members of this club are quite able to do that for themselves. I am indeed prejudiced in favor of the Edison system, but am not unwilling to give credit and recognize the very valuable work done by the other inventors. It is hard, however, for me to forget that portion of the history of incandescent lighting with which I was closely identified.

I well remember when there was no incandescent electric light used in the United States. When Mr. Edison had satisfied himself that the (so called) subdivision of the electric light was economically and commercially possible, his public announcement was greeted with derision by high authorities in this and in foreign countries. In the light of subsequent developments most of these gentlemen generously acknowledged their error. In like manner, I shall claim the privilege of stepping off the track, if the locomotive represented by the alternating current shall threaten to run me down. The unanimity with which the arc light companies first derided and subsequently grabbed for the incandescent business always refreshed me as a striking illustration of the prevalence of electrical "cheek." The avidity with which they are now rushing to the alternating current makes me fear that their experience with the constant current has not been sufficiently profitable to satisfy their vaulting ambition.

Early in the development of the Edison light I had the exquisite pleasure of attending Professor Morton's famous lecture to the members of the National Gas convention at the Stevens institute, in which he so ridiculed Edison's proposed division of the electric light that his audience was overcome with the utmost hilarity. The gas interest has since that date had abundant cause for reconsideration, and at last, aided by hard knocks and inherent practical business sense, has come to the conclusion in many instances that the electric light is a good thing, which they will own themselves. I pioneered the incandescent electric light in Chicago, although closely followed by my friend, Mr. Warren, who has since always been able to keep any one from feeling lonely in the business, and it is no small gratification to me that some of the men who were most violent in opposition to the incandescent light have since fitted up their buildings with it, and even made large investments in electric lighting enterprises. Having actively participated for four years in the early introduction of the Edison constant current system of incandescent lighting, and being somewhat familiar with its steady and successful subsequent progress, I am not prepared to rashly follow the lead of others into the alternating system until certain that it will not lead to disaster. We have had these bursts of enthusiasm in the business before, of which the premature efforts at the introduction of storage batteries are a striking illustration. I believe in proving all things and holding fast to that which is good, rather than rashly take up what in comparison can only be shown to have a promise of success. Now let us see if we can find a few shreds left upon which to hang our belief that the constant current system of electric distribution is still entitled to preference as against our mortal enemies who seek to overwhelm us with the alternating method.

Not having even attempted to figure a system of electrical conductors for nearly three years, and my attention having since been largely turned in other directions, I shall not attempt, after the able expositions of the learned and more experienced members of the club, who have preceded me, to treat the subject from a scientific standpoint with fancy diagrams by way of illustrations. I shall be compelled to confine my attention largely to the commercial side of the question, but as Mr. Edison has often said, "Any invention which is not commercial is N. G.," and as we claim the constant current system is commercial, in that it now returns a profit to the investor where ordinary good judgment, practical skill and management is employed, something may still be found worthy of consideration from my point of outlook. Considerable has been said in the progress of this discussion upon the subject of electrical engineering ability.

In the electric field I know of no undertaking more brilliant in conception, audacious in execution and successful in operation than the first district station of the Edison Illuminating company, in New York city. At the time it was planned electric incandescent lighting was generally believed to be impracticable. The lamp, dynamo, underground conductors, meters, regulating apparatus and various appliances had to be perfected and to a large extent devised. This constant current, low tension system was installed in the financial center of this country in the teeth of the most powerful gas companies in the land, and in a district where the buildings are largely vacated at night, so that the amount of light required is relatively small. The light was to be sold by meter, and had to win its way not only in competition with gas, but with other forms of electric lighting. Croakers prophesied that the system would not work; when it did work that it would not endure, and when it endured that it would never pay. It will be five years in next September since current was first turned on the system, and with the exception of two hours on a single occasion when the safety catches in the feeders burned out from insufficient capacity, there has not been a single instant, night or day, when the current supply has failed. When some of the alternating current stations with their dynamos and single pairs of conductors have made a record equal to this, the capital invested may begin to feel secure, for constancy is a prime factor in electric lighting. The means employed for regulating the light have been found reliable and satisfactory. Not the least interesting feature in connection with the operation of this system to me is the means employed to locate faults in the underground conductors by tests at the station while current is flowing over them. It is not unusual to locate from the station within a few feet of the spot where the fault exists. Although the Edison tubes in use are the first manufactured, they have proved reliable in the main and are in good condition. The meters give correct measurement of the current used, and customers pay their bills. 11,000 16-candle lamps are daily supplied from this station. Although this is the first large incandescent system ever put into operation, and although the installation was made on the two-wire, 110 volt multiple method at a cost certainly double and perhaps treble what it could be duplicated for to-day, the investment is profitable. This success has resulted in the capital being furnished largely by the original investors for the four Edison stations now being installed in New York with an aggregate capacity of 150,000 lamps. A gentleman of large electrical and business experience, who recently rigidly examined the books of the Edison first district in New York with the view of a considerable investment of his money in the Chicago Edison station, which investment he decided to make, assures me that the station is earning 8 per cent. upon its capitalization. It is interesting to note that the Chicago Edison station which is now being erected here will have capacity for 50,000 lights instead of 30,000, as originally intended. The money furnished for this work comes largely from parties who have been interested in the Edison business in the west for several years past. The large Edison stations in Boston, Philadelphia and elsewhere ought to convince any fair-minded man that profit is to be realized in the use of a constant current low tension system. Capitalists as a class do not transact business on a sentimental basis, and if our alternating friends shall be so fortunate as to scoop the present investors in the constant current system by a competitive system, we need not waste much time in sympathy and lamentation. We, as members of the dear public, may get some benefit in the price at which light can be had. My only suggestion is that our alternating friends hurry up, for operations in the Edison constant current system are in early contemplation, which, for the amount of capital involved, rivals the Chicago Gas trust syndicate. An established electric light industry is a hard thing to unseat, and time, experience and readiness for operations are valuable elements toward early success. I consider it conclusively demonstrated beyond cavil or dispute that capital invested in Edison constant current installations in large areas of compactly built cities under the most adverse circumstances in the present state of the art will form a profitable investment.

As the opinion prevails to a considerable extent that the alternating system presents peculiar advantages for small towns or cities with a scattered population, I will cite only one instance in favor of the continuous current, three-wire Edison system. The city of Laramie, W. T., has a population of 6,000 people, and fairly represents the average place of that size. There is now in operation at that place an Edison station supplying 4,000 lamps. A personal friend who invested some money in this station largely upon my advice informed me that it is paying him 10 per cent. This earning has been made until recently exclusively from the sale of current for incandescent lighting, the station being a little over two years old. Early in the present year the sale of current for use in supplying power was commenced, and the prospect is that within the present year the income from this source will equal if not exceed the income from light. I will instance one or two customers to whom current for power is sold. The Laramie Milling company is supplied with current for two 25-horse

(*Continued on page* 287.)

1 Read before the Chicago Electric club, June 4, 1888. The seventh of a series of papers upon the subject: The "Continuous vs. the Alternating Current," before the club.]

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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EASTERN OFFICE, 30 TEMPLE COURT, NEW YORK.
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Notice to Subscribers.

Subscriptions to the WESTERN ELECTRICIAN, weekly, at $3 per annum and *The Electrical Engineer*, of New York, monthly, at $3 per annum now filled from this office at $5 per annum for both journals.

The Electric Age has come out in a new dress and increased in size. The new editor, Walter P. Phillips, takes hold this month and evidences of his work are seen throughout the journal.

THE executive committee of the National Telephone Exchange association have fixed upon Tuesday, September 4th, as the day and New York city as the place for the next annual convention.

ON the 4th of June Governor Hill of New York signed the bill abolishing hanging for all murders committed after January, 1889, and substituting death by electricity. We can only add that we believe the action of the governor is to be commended.

"TO OUR Chicago contemporary: You have guessed our meaning completely. The reason why bad workmanship is seen on a larger scale in the States than in England is because practical electrical work is conducted on a larger scale in the States," so says the London *Electrical Review.*

MR. DUPONT, director of the Museum of Natural History at Brussels, has returned from the Congo after studying eight months the geology of the Kassair river. He found evidences of large deposits of iron and copper. The latter discovery will not be pleasant news to those interested in the French syndicate.

"THE comparative values of alternating *vs.* continuous current systems have been under discussion at the Chicago Electric club," says the London *Electrical Review.* "Professor Badt read a paper which led to an interesting debate, in which several men known to us took part. The members seemed fairly divided on both sides."

THE London *Spectator* thinks there is a danger in executing criminals by electricity. Its criticism is, that too ready a means of inflicting death is calculated to deaden the natural and beneficial horror of the execution. There would not be, this paper thinks, the same reluctance to impose the extreme penalty which now exists and which causes jurors and courts to scan so closely every fact in a capital case before condemning the criminal to the gallows.

MR. Bliss' paper read before the Chicago Electric club last Monday evening advocates the continuous current, as opposed to the alternating current, from a financial standpoint, and he had the advantage of dealing with accomplishments of the past and not promises of the future. The phase he presents lends new interest to the discussion of the general subject, "The continuous *vs.* the alternating current," now drawing to a close, and his paper merits careful reading. The paper is eminently practical throughout and is within the scope of all.

THE board of aldermen of New York at their last meeting agreed to reconsider their refusal to grant the Fourth avenue railroad company the privilege of using electric motors, though they did not take any final action. If all the members of the board are like the one described in our New York letter, who said the city had prospered in its early day without railroads, and he could see no reason why the residents could not get along without them at the present time, the advocates of progressiveness might well sit down and fold their hands. However, the railroad in question will use motors on a part of its line, and probably their use there will lead to their use on the entire line.

COUNSEL have been engaged in Chicago durthe last week in summing up in the suit of the Bell Telephone company against the Cushman Telephone company. Judge Blodgett's decision in the case will be awaited with the greatest interest, not only by the parties to the action, but by the public generally. The case is warmly contested, as defeat will be a crushing blow to either party. Judge Blodgett made a curious statement before the arguments were begun, to the effect that the subject of telephony was entirely new to him, as he had never used a telephone and had never seen one, except as he had carelessly noticed the boxes. Such a statement in view of the general use of telephones seems almost incredible. Certainly, the learned court must be, as he said, entirely impartial and unprejudiced in dealing with the case.

THE last of electrical patents issued this week speaks well for the activity of the electrical department of industry. During the week ending May 29th seventy-three patents covering electrical applications were issued from the patent office. A general subdivision into various recognized departments is interesting, as showing those in which inventors are most busily engaged: There are 14 patents relating to instruments and devices of measurement and testing; 2 to telegraphy; 2 to the telephone; 3 directly to the motor; 4 directly to the galvanic battery; 4 directly to the secondary battery; 1 to a thermo-electric generator; 26 to dynamos and electric light apparatus, and the transmission and distribution of electricity for purposes of light and power; 17 to miscellaneous applications. Among those relating to electric light apparatus are quite a number covering a whole alternating current system to gentlemen engaged with the Westinghouse company. The columns devoted to electrical patents this week will be found very interesting.

"MR. ADAMS of Illinois is trying to have the telephone system, by which the opening of bridges in the Chicago river for the passage of vessels is controlled, completed by the erection of a telephone station at the light-house, so that it can be known in advance how many vessels are to go up the river, as it is now known how many are to go down at a given time. Mr. Adams is finding some trouble in getting through the circumlocution incident to having anything done by the government, but expects to accomplish his object in time."—*Dispatch from Washington.*

The system referred to in the foregoing is one designed by Professor Barrett, city electrician of Chicago, to reduce the number of times the bridges are opened, and in turn reduce the annoyance to pedestrians and drivers of being delayed by open bridges. The system is very similar to that followed by train dispatchers, in that the movement of vessels is controlled from a central office, and a number of vessels passing up or down the river to any one dock are grouped and sent through the draws at one time. The system was tried last summer and proved its merit. A telephone at the light-house would be of material assistance, and there should be no delay on the part of the government in ordering one established there.

MAYOR HEWITT is sensible on the electric lighting question, as he is on most subjects. His rather snappish remarks before the coroner's jury which was investigating the cause of Lineman Murray's death, subjected him to considerable criticism, but no one can find fault with the statement he made before the Gas commission. He is quoted as saying: "In the present state of the question we must decide whether or not we will extend the area of electric street lighting. The newspapers have taken it up and discussed its dangers. I believe they have greatly exaggerated them, and I have made some inquiry on my own account. I find official record of only four deaths from accident due to the high tension current of the arc light systems. Two of the cases were those of linemen, who, with their knowledge of the business, must have been careless. At any rate their deaths were caused by distributing wires, and not by those strung through the streets. But there appears to have been two deaths from loose wires in contact with the light wires or from some defect in insulation —one in East Broadway and one in the Bowery. There are 7,000 arc lights in the city, and such a percentage of accidents is small. No human improvement is made except at the cost of some accidents, but it seems to me that proportion here is so small as to be almost unworthy of notice. The newspapers have had so much to say, though, that the public is excited."

WE give this week a portion of the discussion following the reading of the papers before the American Institute of Electrical Engineers in New York May 16th. There is much that is interesting and instructive in the report of the discussion, and it may be said that the discussion rivals the papers in their attraction of attention.

Mr. Delany's paper on "Protection of the human body from dangerous currents," is a topic that is receiving and should receive most careful attention. Electricians and those working on circuits deal with a force that gives no warning to any of the senses until the body gets into the circuit, and the shock—sometimes fatal—is received. Study in the direction of protection of human life from the dangers of electricity will be time well expended.

This subject brings to mind a paper upon the same line of thought by Prof. F. B. Badt, read before the Chicago Electric club August 22, 1887, and published in No. 9, Vol. I, of the WESTERN ELECTRICIAN. The conclusion the writer of the paper reached was that the danger depended upon the coefficient of self-induction. In support of this view he cited the fact that a battery and a dynamo, both delivering current of the same electromotive force and intensity in a straight circuit, did not offer the same danger; that is, that the battery shock might be hardly perceptible, while the shock from the dynamo might prove fatal,—depending entirely upon the self-induced or extra current set up from the field magnets. His final conclusion "that there is absolutely no safety save in letting electricity severely alone," was based solely upon the fact that it was impossible to know whether there exists in any circuit for the transmission of electrical energy the means of setting up the extra current.

(*Continued from page* 285.)

power Sprague motors. It is a modern roller mill with the capacity of 100 barrels of flour per day. There is no boiler or engine about the institution. For reasons connected with the manufacture it was decided to use two 25-horse power motors instead of one of 50-horse power. The manager of the mill says the power is satisfactory in every way, and as constant as the best regulated automatic engine. He enumerates the following advantages: Ease in placing the power where wanted, and thus avoiding long lines of the shafting or more objectionable belts; economy of room for power plant; saving of first cost of power plant, interest and taxes; 30 per cent. saving in insurance rates; an economy and increased reliability over steam power for his use. It may be unfair to the Edison interest to give away to our alternating current friends the price which is paid for the power, but in this case I am going to risk it. The average load on these two motors is 23 000 watts, and the price paid is $292 per month of 26 days, ten hours per day.

The Laramie Edison company also supplies current to a rolling mill for a 20-horse power Sprague motor. Power is communicated from the motor to 120 feet of three-inch shafting. This shaft drives four spike machines, two bolt headers, two nut pressers and a large number of threading and tapping machines, including some emery heads. The average load is 11 250 watts for twenty hours a day, which is paid for at the rate of fifty cents per hour. The mill was formerly run by steam power at a larger cost, and in not nearly as satisfactory a manner. These mills are supplied with current directly from the regular feeders of the Edison station. In addition, the Laramie company is selling current for a number of smaller motors. Already the income of the company is at the rate of over $6,000 a year from the sale of power. These statements are made upon the authority of R. M. Jones, the manager of the Laramie Edison company. This illustration furnishes conclusive proof that the Edison constant current, 3-wire 220 volt system in cities of the smaller class, can be made profitable.

It is appropriate at this point to give the question of the sale of current for power from electric generating stations additional consideration. This branch of the business has already acquired magnitude, and is destined to grow into gigantic proportions. The maximum lighting load of a station is seldom carried for more than from two to three hours in the twenty-four. During the remainder of the day there is a large surplus capacity in boilers, engines, dynamos and conductors, which must remain idle unless employed otherwise than in supplying current for light. The sale of current for power comes in to fill this gap as it is needed largely at a time when light is not required. The sale of a single electrical horse power of energy for ten hours is equivalent to the sale of forty-eight 16-candle lamps for three hours, which would be a large average burning. It is a fact where the Edison stations are run day and night that the current sold for power exceeds the current sold for day lighting, and in many cases it is rapidly growing toward an equality with the entire sale of current for light night and day. I will give one example of what an Edison station can do in a city of the medium class.

The Detroit Edison station is now supplying current for about 9,000 lamps, and they are behind their orders for installations to the extent of several hundred more. In regard to the sale of current for power it is supplied as follows: Printers 6, newspapers 1, opticians 1, laundry 1, chemical works 2, wire works 1, shoe manufacturers 3, book binders 1, machine shops 2, telephone companies 1, knitting works 1, hydraulic elevators 3, elevators 3, sewing machine shops 5, dentists 6, jewelers 3, ice cream dealers 1, sporting goods 1, ash elevators 1, storage boilers 1, also quite a large number of small motors for single fans, sewing machines, etc. The party taking the largest amount is the Detroit *Tribune*, thirty horse power, and the knitting works take 15. The present aggregate sale amounts to 162 1-2 horse power which at $100 per year makes an income of $16,250, which is not to be despised. In view of such a source of revenue which is available to the constant current system, I cannot avoid the conviction that the capitalists should use extreme caution in investing his money in alternating systems which so far are only able to promise a successful motor for use in connection with their current in the dim hereafter.

A great hullabaloo has been made in this discussion about the cost of copper in connection with the constant current system. In the territory which it is the custom to attempt to cover with the Edison system the cost of copper seldom equals 20 per cent. of the entire cost of the installation. As the constant current has unrivalled capacity for producing revenue within the territory covered, it certainly ought to be greatly preferred even if there was a large margin of cost in copper against it. I will give one or two examples of what the actual cost is for copper in a couple of Edison stations now in process of installation. For one installation which provides 100 street lamps scattered over an area of 1½ miles square and 500 lights for stores, residences, and churches in a mile square, the entire cost of copper at 20 cents per pound is $3,000 or $5 per lamp. For another installation where 100 street lamps are scattered in one area two miles square and 800 inside lights in an area about a mile square the entire cost of copper at 20 cents a pound is $3,102, or $3 44 per lamp.

I have not as yet seen or heard a satisfactory answer to Mr. Leonard's statement of the comparative cost of the conductors of the two systems when converters at $3 per lamp are taken into consideration for average practical installations at reasonable distances. As Mr. Leonard has already stated the load diagrams of the Edison stations show that the maximum number of lights burning at one time is only 40 per cent of the number of lamps actually installed. I want to emphasize the point that conducting capacity in the feeders and mains is only supplied for the highest number of lamps carried at one time, and yet in any one building all the lights may be in service at once. Therefore conductors must be supplied for the full lamp capacity. On a general Edison installation with conductors for say, 1,000 lights, 2,250 lamps may be installed in the buildings. The investment for converters from this standpoint is enormous. Parties engaging in the electric lighting business presumably do so with a view to doing the great bulk of the lighting in the territory covered I do not suppose over ten per cent. of the gas jets in Chicago are ever lighted at one time. The party undertaking to supply converter capacity for a number of lamps equivalent to the gas jets in Chicago will have an investment on his hands sufficient to appal any one who is not swayed by an imaginary advantage.

Criticism has been made upon the constant current station on account of the amount of apparatus it contains. For my own part I greatly prefer apparatus located at a central point, in the hands of competent employes to keep it in order, to scattering a lot of converters all over creation where they will necessarily make a great deal of trouble. Any one who has had experience with electric appliances in which insulated wire is used and through which powerful currents pass, whether it be telegraphic, fire alarm, electric light, or any other form of apparatus, knows that it is liable to frequent troubles, and when converters are placed on poles or the exterior of houses, or even in the interior of houses where they necessarily must often go in damp places, the claim that they will not need frequent care and attention is certainly all bosh. Moreover, in many of the latest Edison stations feeder equalizers are dispensed with altogether, so that switches, ampère and pressure indicators constitute the sum total of the special appliances.

It is just as easy to run constant current generators with a separate exciter for the fields as is the case in the alternating system, so I fail to see any special force to that argument except that it is not usually done. The advantages to my mind of being able to multiple arc dynamos, and of having a number of feeders supplying a common system of distributing main conductors, is very great. The auxiliary conductors used in connection with the alternating system bring up the cost for copper in a measure, and add to the complication of their circuits. The objection which has been urged to the operation of two classes of apparatus in the same station will hardly hold so long as our alternating friends find it necessary to use constant current dynamos to supply the arc lights operated from their stations. I am still unable to see any special advantage for the 50-volt lamp, which is claimed to be specially adapted for alternating work. It certainly increases the size of the inside wiring as compared to the 110 volt lamps and places that part of the alternating installations in antagonism to the principle which is claimed to be so advantageous in the exterior conductors. No doubt lamps of the same voltage from different manufacturers will vary considerably in results.

A recently published article in regard to the incandescent lamps, written by John W. Howell, who is a high authority, says that lamp renewals should not exceed 15 per cent. of the operating expense of a central station plant. I am not aware that the cost of Edison 110 to 120 volt lamps exceeds this figure, nor that the Edison company is unwilling to guarantee an equal number of lamps to the horse power and an equal life with any other lamp in the market.

An admirer of our friend, Mr. Cutter, says he always likes to hear him talk. I confess that during the progress of this discussion Mr. Cutter has helped me to understand how it is that the Thomson-Houston company secured such a large slice of the electric business, for his talk is very plausible. As against his theory that the eye judges the light at the instant of maximum incandescence when the impulses are in the lamp, and hence that the alternating current may be more economical than the constant current in the incandescent lamp, I want to suggest that the successive impacts of the alternating current must have a tendency to impair the structure of the carbon, for in my experience rapid changes in current have been a fruitful cause of brevity of lamp life.

I must also take exception to Mr. Cutter's view that a conduit system with small ducts through which conductors can be hauled from time to time between manholes located at convenient distances is the most desirable. The experience with this system in Chicago certainly does not bear out this conclusion. If with a high tension alternating system it is going to be necessary to have new conductors hauled in every few days because those in use burn out, I can understand part of the necessity for such a construction. How such a conduit system is adapted to an electric distribution from which taps must be taken every few feet in order to enter buildings, is not clear to me.

Considering the expense, I still believe the Edison system of underground conductors, all things considered, the best which has yet been devised for incandescent work. It is easy to increase the thickness of the iron casing if the soil makes it advisable to do more than guard against mechanical injuries. I am aware that the Chicago troubles with the high tension underground conductors have been greatly lessened recently by a heavy increase of the insulation employed. This is a fact which stares the alternating current in the face. Large first cost for insulation and constant care and expense to maintain apparatus to prevent an undue percentage of waste in the current supply. The feeders in an Edison 3-wire system are usually figured at ten per cent. loss, the distributing mains at two per cent., and the inside wiring, at the same or a total of fourteen per cent, under conditions of full load. As has been stated, the percentage of loss of current in the conductors is proportional to the load, so that the average loss is much smaller, say five or six per cent. With the alternating current the opposite is exactly the case, for the converter has its highest efficiency with the maximum load, but runs down materially as the load decreases. The alternating current system being practically confined to the sale of light for the present, and the maximum capacity of the converters being seldom called into use in a general lighting system, the advantage seems to be against it for economic use for distances which the constant current system attempts to supply.

I have always been strongly in favor of selling current for the incandescent light by meter measurement, and thereby profiting from the long experience of the venders of artificial gas. I am well aware that there are Edison Central stations selling light by the contract system which earn twenty per cent. on their capitalization, but such cases are exceptional, and it is my conviction in the long run that method will not be found satisfactory either to the customer or the companies. There are now thousands of Edison meters in successful use, and until the alternating companies shall perfect a meter and put it into extended use, the lack of this will continue to be a great objection to that system.

Allusion has been made several times to the excessive cost of the ground upon which the Edison stations are located, and I still want to say a few words on this branch of the subject. It has been stated to the club that in Boston capital has been offered to the Edison company to erect a building sufficiently large to accommodate the station and provide enough additional room for rent to pay a handsome profit on the investment in the ground and building. Our president has suggested that as other large corporations frequently provide their own accommodations in this way, electric light organizations may do so also.

The Chicago Edison company cannot be accused of any effort in this direction, but is evidently inclined to meet its fate strictly in the line of the sale of electric energy. I desire to repeat the statement heretofore made by myself that when a station is centrally located the sale of exhaust steam for heating purposes to surrounding buildings should become a large source of revenue. In combination with the Johnson heat regulating apparatus, especially favorable results can be obtained. The Chicago Edison station already has applications for steam heat, and I have no doubt this source of revenue is to become an important factor in electric lighting stations. When a station is located in the suburbs the exhaust is necessarily thrown away.

It should be distinctly understood that I am no alarmist in regard to danger from electric lighting currents. I believe there is no electric lighting in use which begins to compare in danger to property and life with gas. Still the fact that it is thought advisable by some to ground the secondary circuits and by others to ground a metallic shield between the primary and secondary coils in the converters for the protection of customers of the alternating system, is in itself a confession of danger. Either method appears to me to make a series of first class lightning arresters out of the converters, well calculated to protect the community at large at the expense of the pocket-books of the stockholders in the alternating companies. In Edison's early work on the incandescent light he frequently expressed the determination to devise a system which by no possibility could injure any man, woman or child. That was a noble ambition, and I for one shall be sorry to see for economic reasons his system for general use so modified that this element of safety cannot be claimed for it.

A gentleman connected with a life insurance company recently stated to me that his company had decided to make all employes engaged in the dynamo room and on line work of the alternating special risks, the same as the arc light employes. This is not the case with the employes of the low tension constant current system. The public has a right to demand the highest standard of safety in electric lighting, and there have been few more commendable things done in this city than the establishment of a rigid inspection of electric light plants, vexatious as Brother Haskins sometimes makes himself. The tendency of legislation and the courts is to hold corporations to a strict accountability for losses and injuries arising from carelessness of employes, in management and construction. It will be absolutely necessary in using high tension alternating or constant currents to maintain a high standard of insulation and efficiency to avoid the assessment of heavy damages in case of accidents. In this respect the low tension constant current system has a great advantage over high tension alternating currents; even where a high tension constant current is transmitted a long distance and converted by a motor generator, there is less risk, for in case of accident at the station it would be quickly discovered and remedied by the attendant, while with the alternating current it is possible to bring a death current within reach of the individual users of the light where the danger might not be discovered until a fatality had occurred.

Mr. President, I owe the gentlemen connected with the club an apology for not having brought with me a diagram to illustrate the subject under consideration. I contemplated bringing a picture of a 15 story office building with the windows omitted and a system of converters substituted in their stead. I thought it probable from the brilliant way in which converters appear to some of us that with such an arrangement by opening them on the inside, tenants would get all the light they wanted without the aid of the sun or additional apparatus. Such an illustration would be in my opinion about as fair as some of the diagrams shown here of the wires which cover northern Minnesota so as to shut out the buildings in St. Paul from view. If the club will excuse my neglect in not bringing the diagram on this occasion I will promise to make amends in the future. I make this pledge all the more freely because promises and futures seem to have a current value when electric distribution is under consideration.

C. C. Haskins presided at the meeting of the Chicago Electric club last Monday evening. No business was transacted. Mr. Bliss read the foregoing paper, and, at its close, on motion of Mr. Kreidler, was tendered a vote of thanks.

THE CHAIRMAN: Gentlemen, the paper is before you for discussion. We shall be pleased to hear from any one who feels interested in the matter.

MR. WARNER: Mr. Bliss' paper, bearing upon the financial side of the question, has been of great interest to me. I feel that there are several little points upon which he touched to-night that it is time greater stress was

laid upon. In several of the papers which have been read thus far, they have been mentioned, merely mentioned. Mr. Bliss spoke of insulation, the cost of insulation of the alternating system, and the increased thickness of insulation which has been found necessary upon high potential circuits, such as are light circuits in common use in this city; and, following that, he spoke of how the difference from loss or defective insulation might affect the two systems relatively. I think he has made a great point by bringing out clearly the relative loss that would take place in current, in electrical energy, in the two systems with a given insulation resistance. I do not think it will require very much electrical figuring to show to the average electrician that with an insulation resistance of 1,000 ohms that e loss on the alternating system must be very serious; while with the Edison or any continuous current system, it is scarcely a matter of any moment whatever. I will again say that I think Mr. Bliss' paper bearing upon the continuous current system — the continuous side of the question — a very good one, and one which fully backs up my views of the case.

MR ANDREWS: Seeing that Mr. Bliss has confined himself almost entirely to facts and figures without indulging in any flights of imagination as to the possibilities of the future development of systems which are not now perfect, I do not see there is very much ground for discussion in what he says. I became very much interested in listening to what he had to say; his calling up some of the early reminiscences in which he and I were both engaged, was quite refreshing to me. I quite agree with him in all he says in regard to the financial part of the work at the Edison stations. Of course, the opponents of the direct current system may show that a great many of the stations are not paying. That is true. But I have heard it stated in times past that there is not a single railroad in England —I do not know anything about American railroads—that has not met with financial disaster, and has not had to reorganize with new capital. That is no reason, because of the failure in the construction of the first railroads, that the other railroads should not be successfully operated. And so with the stations using continuous currents. Because through failure in construction in the early days of the art, some of them at the p esent day need reconstruction and are not at present paying, that is no argument at all to just-minded men against the direct current system I think, on the contrary, it simply shows that we want a little experience in the matter. It seems that the alternating current has a peculiar fascination for men of a slightly imaginative turn of mind, because the possibilities are so great. Varying potential is its chief feature; and, as Rankin Kennedy says in his little work, the only advantage of the alternating system is the fact that its potential can be varied readily, and thus the current can be brought to places where it could not be otherwise brought with a current whose potential could not be varied. I think that is the one thing which will hold up the alternating current. In fact, I can not see any other way in which it has an advantage over the direct current system. But it certainly has that advantage that its potential can be varied. When I see an alternating current brought into use in isolated plants then I shall begin to think that there is something startingly advantageous in its use. But, until that time, I think that the alternating current can only be used in places where it is impossible to reach by low tension current. I am in favor of low tension current because of safety. Safety to life, although it is one of the points brought up by members in papers read before you—has nevertheless been very lightly touched upon. Instead of that point of safety to life being placed second, or third, or fourth on the list, I think it ought to be placed the very first. And I think that Edison had that in mind when he said, as Mr. Bliss stated just now, that it was his aim to bring in a system in which it should be impossible to hurt man, woman or child. That he certainly has done. And nobody can say that the low tension direct current system has in any way hurt any one at any time. It is impossible to get any hurt from it.

MR. TAYLOR on being asked to make some remarks said that his opinion would be seriously affected by the size of the order wherever it was placed. [Laughter.]

CHAIRMAN HASKINS being called upon said that he had purposely refrained from giving any opinion on the subject, and that he did not feel it his duty to express one except in an official way.

MR. WARNER: Mr. Andrews, in the course of his remarks, quoted Rankin Kennedy as stating that the chief advantage of the alternating current was that its potential could be varied. I must say that it is not altogether clear to me wherein that constitutes an advantage, or that it is so to any greater extent than it is with the direct or continuous current. We certainly know we can vary the potential of both alternating and direct currents, and that in the transmission of electrical energy or power in any way that we can do all and anything with continuous currents in the way of variations of potential that we can with the alternating. It may be that Mr. Andrews wishes to qualify his statement somewhat. I merely say this in order to hear further from him.

MR. ANDREWS: I desire to qualify my statement by saying that I think Rankin Kennedy said that the chief advantage of the alternating system lay in the fact that its tension could be altered without moving the machinery, or rather, without mechanical motion.

The club then adjourned.

The Richmond Westinghouse Plant.

To the Editor of the WESTERN ELECTRICIAN.

RICHMOND, VA., May 29, 1888.

I notice in the WESTERN ELECTRICIAN of May 12th a statement made by H. Ward Leonard in a discussion by the Electric club, in answer to a paper by George Cutter, as follows: "I happened to be at Richmond where they were operating and constructing an electric railway. The railroad was deriving its power from the station, and in the station was a Westinghouse alternating current system. I asked him where the converters were and how they worked, and the reply was that they burned out about twelve or fourteen. The gentleman I asked was not quite sure, but he thought they were burned out, and in regard to the armatures he was not quite sure if he had not burned out one or two."

I am, in justice to the Westinghouse company as well as my own company, obliged to answer this statement, by saying that it is entirely untrue in every particular. Out of converters with a total capacity of 2,500 lights of 16 candle power, now running about four months, we have not lost a single one nor have we ever had any trouble of any kind. The current is on the system of wires 24 hours per day, and the light is at the customers' disposal any time they want it. We have experienced no trouble of any kind and our customers are entirely satisfied.

The same may be said of the armatures; we have had no trouble with them, much less burn one out. The dynamos are running above their rated capacity and often run for 18 hours at a time. I see no reason why they should burn but either. We are entirely satisfied with the results obtained from the Westinghouse system, and know that we are getting results here almost impossible to obtain with a direct system.

W. H. COLE,
Electrical Eng. and Supt.
Virginia Electric Light & Power Co.

American Institute of Electrical Engineers.[1]

PART I.

The meeting was called to order at 10:30 a. m, May 16th, by T. C. Martin, vice-president

The CHAIRMAN: As you are aware, gentlemen, Mr. Edward Weston was elected president of the institute last night. I have been informed that he is not at all well, and that it is possible that his sickness may, while not preventing his attendance, delay him very much in getting here this morning. I think it would be well, however, if we were to proceed immediately with our programme, and I will therefore present, as first upon the programme, the paper by Mr. P. B. Delany, on the "Protection of the human body from dangerous currents;" and as I have promised Mr. Delany to read that for him, I will ask Professor Anthony if he will preside while I do so. Professor Anthony took the chair, and Mr. Martin read Mr. Delany's paper.

The CHAIRMAN: The paper is now open for discussion.

P. B. DELANY'S PAPER.

G. M. PHELPS, jr: I suppose it will be somewhat difficult to bring the merit of the proposed protection to a test by a trial by lineman, or upon any person. There will probably be few investigators enthusiastic enough to learn the possibilities of this protection by submitting to a test. But unless electricians share the sensibilities of the Anti-vivisection society, a great deal might be learned as to the efficiency of the means of protection suggested by Mr. Delany by judicious experiments upon animals. I suppose there will be an opportunity to get an abundant supply of dogs of various grades the latter part of the summer. I merely make that suggestion as pointing out a method of testing the efficiency of this means of protection. I am quite serious about it. I can see no reason why very satisfactory tests might not be applied to various animals; and some of these physiological questions implied in Mr. Delany's paper be determined to a great extent.

MR. MARTIN: Mr. Delany was not at all anxious that the apparatus he had devised should be exhibited, not desiring in any way to use the institute as an advertising medium—an advertising medium being a bad thing; but I was very much interested in the subject myself, and I took the liberty of bringing some of the apparatus with me. If it be the desire of the members, I will show it. [Mr. Martin exhibited the apparatus.]

R. W. POPE: One of the difficulties encountered in the practical application of a safeguard of this kind, according to my investigation, has been the difficulty in enforcing its use among the very men whom it may be intended to protect. I have heard it stated that miners were averse to carrying safety lamps; and we all know that there are insulated pliers now on the market, and that india-rubber gloves, when perfect, answer as a protection; yet men go out on their daily duties without observing even these precautions, and consequently we need something more than the actual invention of a device that will perform its duty in order to save lives; because if men are so careless, and so regardless of the dangers as to go to their duties without preparing against them, I do not see how we can do anything to wholly prevent accidents.

JOSEPH WETZLER: In looking at the question from another standpoint, it strikes me that the question which is involved in the fatality of an electric shock depends to some extent on the electric work done upon the body as upon the potential. Let us take, for instance, the case of a man struck by lightning. We frequently hear of men having been struck, and surviving. Here there can be no question of the fact that the potential was at least many hundred thousand volts. Yet on the other hand we see a man touching a wire of 1,500 or 2,000 volts and being killed. In one case we have an enormous potential, but an exceedingly small current; in the other case a small potential, comparatively, but a large current; yet in the latter case the electric work far exceeds that of the lightning stroke, and the man's death ensues. Therefore I should say, that the question involved is as much the electric work done upon the human body as the potential, and if by means of such an apparatus the work done in the human body can be decreased, I think it would have, in that sense, some value; that is, if you could shunt a large part of C, a man's life might be saved, whereas, if it were not shunted, it might enter his body and cause his death.

DR P. H. VANDER WEYDE: We have lately seen in the electrical journals assertions about the number of volts of potential of a current persons could stand without injury. It has been stated that a thousand volts could be taken with perfect impunity. But these writers forget that there are two elements to be considered: the potential and the quantity, as stated by the last speaker. It is the potential of amperes and volts which does the damage. When we have a great potential as in a frictional electrical machine we may have, as Prof. Mayer, in Hoboken, lately showed, many thousand volts potential, but no quantity. It will penetrate a distance readily, but the quantity transmitted is very small, so that it is harmless. The sparks of a friction machine do not cause serious damage. But when we take the other extreme, larger quantity and great number of amperes, it is different. We find that in the thermo electric pile there is no electromotive force sufficient to penetrate the skin It has no effect on the body. There is not enough electromotive force even to pass through the liquids of the body. In the galvanic battery we have electromotive force if we use a sufficient number of elements, and we have quantity, if our cells are large enough. There we may have a shock, and a battery of that kind, as large as Sir Humphrey Davy used, of some four thousand elements, may be fatal to an experimenter. It is the relation between the two. There ought to be a sufficient number of volts and a sufficient number of amperes both, in order to destroy life. That is the case with lightning. Usually lightning is fatal, because there is sufficient quantity, and at the same time there is electromotive force, as we see by the enormous length of a stroke of lightning. So it is with dynamos; when the electromotive force is combined with sufficient quantity, then it becomes dangerous; but I want to impress upon all that force alone without quantity, without ampere currents, is harmless; and so the ampere currents alone are harmless. It is the combination of the two in which lies the danger.

PROF. ELIHU THOMSON: I quite agree with Dr. Vander Weyde in the opinion expressed that it is not a question of volts or current alone which determines the fatality of a shock. It is quite possible no doubt, to take a charge from the human body equal to many thousands of volts. One may mount an insulating stool and be charged to a potential of ten or fifteen inches of striking distance, and have it discharged from him without the slightest inconvenience—with no more of inconvenience than would result by the discharge through his body of a very small leyden jar; that I have had experience in, and I can testify that even though such a discharge as that goes directly across the body of a person it has no harmful effects other than a very slight shock, causing a twitching of the arm. In all cases of dangerous shock it seems to me we must have a resistance so low as to permit the volts to send a current of a certin volume through the system. If that current is not attained, it is doubtful whether harmful results will follow. If that current is attained, the harmful results may follow. If we could imagine a man so constituted as to have not more then an ohm resistance, between any two portions of his body, between which are situated vital nerves—nerves whose action is required to keep up the functions of the respiratory organs or the heart—it is quite conceivable that a very small voltage might kill the man. The human subject undoubtedly differs very greatly in resistance, and a fatal shock may be obtained in one case at one time, which would not be obtained by the same subject at another time with equal volts, much depending on the moisture of the skin, and probably the amount of salty matter in the blood. The layer of fat which exists underneath the skin acts as a sort of insulator. All these things will have an influence, and then comes in, in addition, the susceptibility to a discharge. We have reason to believe, I think, that susceptibility varies very greatly in persons. I quite agree also with Mr. Phelps in the necessity of some really scientific investigations, tending to clear up this question. Those investigations, I think, could be carried on with the lower animals, and very valuable data arrived at as to the passage of the current in certain directions through the body, whether the current in its passing includes, say, the pneumo-gastric nerve, which, if it does not act, is sure death every time. The heart must beat in order that life be sustained, and death will occur from heart failure if the heart is not kept beating. If the respiratory organs fail in like manner—if, in, other words, the nerves controlling the respiratory functions have their vitality exhausted that will also be a cause of death. The whole organism depends, I think, upon the nervous system; and it is also a possibility that such a thing as nervous polarization may occur. The molecules constituting the nerve fibres may become set or polarized, so that the brain's excitation cannot reverse them, or cannot bring them back to a normal condition. That idea has been put forward as a suggestion in regard to recovering whether it would be likely that a discharge passed in an opposite direction would, as it were, depolarize the nerve and assist recovery, followed by artificial respiration and other means at command. It has been stated, I think, by D'Arsonval that, in his opinion, the alternating current is not as apt to produce fatal results as the direct currents, and particularly direct currents in the nature of sudden discharges or shocks similar to lightning discharges a large volume of current sent through in intermittent impulses, or sent through in one impulse of considerable power. He, I believe, holds to the opinion that in cases of injury by alternating currents, resuscitation may occur, in many cases, by artificial respiration. If this is the true state of the case, it would seem that polarization had something to do with it—polarization of the nerve structure which is prevented by the fact that the alternating currents are continually reversed. The fact also is certainly true that cases of very severe injury are known, where men have been subjected to a very high potential current, and all the evidences of the passage of a heavy current through their bodies have been found, and the men have not suffered any great inconvenience other than the burning of the hands; so that it would seem as though a critical condition in some cases existed which was

1. Discussion of papers published in Nos. 21 and 22 of the WESTERN ELECTRICIAN.

not present in others. Whether the person himself has any extra power of resistance, or whether his nervous system is so toned up as to be capable of recovering after he has been partially injured, is a question which would naturally arise in connection with this case. I cannot agree that it is a question of one volt, more or less, whether a man is killed or not. I think the time element is probably the most important of all. There are cases in which men have been struck by lightning, and, as you all know, have recovered. Discharges of potential of millions of volts have passed through their bodies, and they have recovered, and in such cases the discharge was undoubtedly a sudden one, and the current passing must have been very considerable. I can not regard a lightning flash as an example of a small current. The heating effects which are present in such cases are sufficient to show that the current may rise to very many hundreds of amperes. For example, if a lightning flash will deflagrate a small iron wire in a very small fraction of a second, it means that current, not volts, has done the work; and not only that, but a very large current. It may have existed for but a short time, but it certainly did exist, and the very suddenness of the action is in favor of very high current flowing. We have numerous instances of telegraph and telephone and other small wires being melted by the electric discharge from the clouds; and when we consider the conditions, we must see that the current is large. We have only to look at a lightning discharge to see that it may appear to us as thick, sometimes, as a telegraph pole. That, if it means anything, means a body of vapor highly heated, of some considerable area. But lightning discharges, according to my observation, are not always single and alone. They are sometimes repeated half a dozen times down the same path, and it is not to be wondered at that a man receiving, say, a discharge of half a dozen flashes, down the same path, in rapid succession, might be killed; whereas a man receiving one flash might escape. I have noted that fact by simply keeping my head going during a thunder storm, and keeping my eyes fixed in one direction, so as to catch the flashes, and they arrange themselves in parallel lines. Oftentimes I have counted as many as six in that way, very quickly following each other.

Dr. Vander Weyde: I had an opportunity some twenty years ago of making experiments upon the conditions of different persons in regard to heavy shocks. When I was professor in the Cooper institute, we had a Ruhmkorff coil which made sparks at twelve inches. I attempted to increase the number of sparks by some improvements, by taking away all possible edges on the binding posts; and I increased the spark to 16 inches. In making those experiments, I was a few times actually knocked down—not knocked down, so much as I had to sit down; I could not help myself. I spoke of it to Mr. Kidder, well known in regard to using small electric shocks for medical purposes. He often came to my place, and I gave him advice about his machine. He said that the idea was exaggerated that such a Ruhmkorff coil as that was so dangerous; and he was willing to take the strongest shock I could give. I said to him, "If you want to take the risk, I am ready; but bring witnesses." He came with witnesses, and one of them was a reporter of the *Tribune*. I gave Mr. Kidder small shocks, at first, gradually making them larger and larger, and he stood it perfectly, and it did not knock him down. He had great power of resistance in that line. The next day an article was published in the *Tribune;* it was a sensational article, headed, "An error in science exploded," and there it was said that all the talk that electricity could kill was nonsense; that the strongest machine that ever had been made was now at the Cooper institute; that it was the strongest was proved by the fact that it had cost not less than $400 [laughter], and that Mr. Kidder, the well known electrician, had stood all the shocks from it; and it gave a great many details which are very amusing to a man posted in electrical science, written by a reporter who was not posted on the subject. But it is strange to me that some persons have great resistance. To be sure there are very few persons who have such resistance in that line, as Mr. Kidder. He is now dead. [Laughter.]

Dr. Moses: The proposed experiments on animals would be very interesting; but it would be very difficult to make the conditions sufficient to satisfy all the requirements that are necessary for accurate experimentation. If you consider that the resistance of a man's body may vary under certain circumstances from ten or fifteen thousand ohms down to four or five ohms, it is necessary that the experiment should be conducted in some uniform way. The skin is an excellent insulator; the blood an excellent conductor; the perspiration an excellent conductor. The varying pressure that we apply in coming in contact with a conductor is a cause of immense variation in the amount of current that passes through us. In fact, we may assume that our nerves convey impressions to us simply by the varying pressure that we give to an object, in that way bringing more or less vital electric action, or what not, into play. An interesting experiment will prove how variable the quantity of current passed through a conductor may be. At the time Mr. Edison was experimenting on a carbon telephone, he thought it essential, and it is essential, that a uniform pressure should be upon the carbon buttons of the transmitters. All of his experiments were made under uniform conditions. For instance, in the ordinary button, which was about 1 or 1½ centimeters in diameter, he applied usually a weight of one gramme, and he found then that they had a resistance of about one ohm. Varying hydrometric conditions affect the conductivity. A thunder storm passing there, where there is moisture absorbed by the carbon, caused a variation in the quantity of current passing through. So there we have got evidently without any apparent changes, changes of current. The skin varies in thickness, so that it is necessary in making experiments to take one constant place and one constant thickness. It will be a very difficult thing to try the experiment; but still it would lead to good results.

With regard to the point that Prof. Thomson raised that it was possible for a man to live after having received a severe stroke of lightning; that is quite true. But I think it may be ascribed to this fact—that most men are saturated with moisture; or rather, they are moist from being in a damp atmosphere. They take refuge under trees, and their clothes become saturated from the drippings, and become excellent conductors. They are struck and the clothes serve to carry the current more than the body. There is an induced action, probably, that affects the man; but the skin being an excellent non conductor, furnishes such insulation that most all the currents pass through the wet clothes.

With regard to the quantity of current that will affect the sensations, one or two interesting experiments may not be unacceptable. If you make a single battery of zinc and copper, placed above and below the tongue, you will feel a slight shock; you will taste a slight acidity, and you will also see a flash, which, with sensitive persons, becomes unpleasant. There you have electromotive force of about a volt—a very small quantity of current. If you take through the temples 100 volts from an ordinary Daniell cell, with zincs about five inches in length, you will get a very unpleasant stunning effect, but not a painful one. There you have the brain brought right in between the terminals; whereas, if you were to take a shock from a Ruhmkorff coil, such as Professor Vander Weyde spoke of, where the spark was 16, 17, or 20 inches, if you were to insulate yourself, you would be able to actually transfix yourself if you were of sufficient resisting capacity. We have all seen blocks of glass, four or five inches in diameter, pierced by a spark from a Ruhmkorff coil. So there, if we find the body thoroughly insulated by the dry skin, and the spark not able to pass by means of the skin, it would pass through the brain in that case, and cause instant death. It would be very difficult to trace the passage of the spark, but I think death would be caused in that way. The location of the terminals, too, has very great influence on the sensitiveness. I, myself, am exceedingly sensitive to the smallest shock. It is so unpleasant that what could be borne by almost anybody puts me in a profuse perspiration. So that it varies immensely in individuals. Those are, however, but data.

CORRESPONDENCE.

New York Notes.

New York, June 2.—At the meeting of the board of aldermen on May 29th the action of the previous meeting was reconsidered, in regard to the refusal of granting the Fourth avenue railroad company the privilege of using electric motors. One member of the board in his maiden speech, admitted that he was opposed to railroads of every description. He said the city had pro pered in early days, done without them, and he could see no reason why we could not get along well enough now if they were entirely dispensed with. Stages were good enough for him. Final action upon the question was postponed. It is thought that the successful use of motor cars, however, on that line above Fourteenth street will soon lead to their use the entire length of the route.

At the meeting of the Gas commission May 31st, Mayor Hewitt availed himself of an opportunity to give the Board of Electrical Control a kick, and at the same time express his contempt for newspaper criticism. The discussion of electrical matters began when the East River Electric Light company (Thomson–Houston system) applied for an extension of its district along Houston street between Mulberry street and the North river, where there are neither poles nor subways. The mayor thought the board should not consider itself authorized to extend the system. He admitted that he took this view because of unusual public excitement, on account of the supposed dangers arising from the electric wires. He considered these dangers greatly magnified, as his investigations of the subject showed that but four lives had been lost, two of linemen, and two of citizens. He did not think this a sufficient cause for so much attention, because with the introduction of every great improvement there must be a certain amount of danger to human life. The East River company was awarded a contract for 433 lamps at 35 cents per night, excepting the disputed district; the United States Illuminating company 352 lamps at 35 cents, losing to the Ball company, a competitor, 48 lamps at 27½ cents; the Harlem Electric Lighting company was awarded 49 lamps at 35 cents and three on the Third avenue bridge at 60 cents each. The Mount Morris company, which cut into the territory of the Harlem company, was awarded 85 lamps at 23 cents for those competing with its rival, and at an average of 35 cents for other locations. Other awards were: To the North New York Lighting company 50 lamps at 35 cents, and the Brush Illuminating company 441 lamps at 35 cents. The representatives of the United States and Harlem companies agreed to light the disputed territory in their respective districts until the matter could be adjudicated.

A meeting of subway workmen was held May 31st, at which complaints were made that the authorities did not grant a sufficient number of permits for the opening of the streets, and that in consequence there were but a limited number of men employed. Another complaint was to the effect that Italians and non-residents were employed at a reduced rate of wages. A committee was appointed to wait on the board of aldermen and request that none but citizens of New York should be employed on the work, and at full union rates.

A movement also by the workingmen is on foot to ho'd a mass meeting at Union Square to protest against the action of the aldermen in refusing permission to use electric motors on the Fourth avenue railroad.

The Bishop Gutta-Percha company, whose reputation for first-class insulated wires and cables has become thoroughly established in electrical circles, has recently entered into the manufacture of a rubber compound for insulating purposes, to meet the growing demand for high insulation in localities where gutta-percha is not suitable. Among other varieties, a twin core of small size for electroliers has been devised, which is well adapted for all work of that character where a double wire is required which will occupy but a small space. This is an entirely new departure for the Bishop company, and a new engine and other requisite machinery have been added to their already extensive plant, under the supervision of an expert practical man, of great experience with the use of rubber compounds for the insulation of wires. It is well known that perfect safety in the installation of either arc or incandescent lighting plants can be insured only by the use of wire of this character, and its more extended introduction will do much to relieve the stigma of alleged danger to life and property due solely to lack of proper insulation. P.

Indianapolis Items.

Indianapolis, June 2.—Considerable damage was done in this vicinity by lightning Sunday night last. The telegraph companies also suffered severely, their wires being badly wrecked east of this city in several places by the high wind.

The electric light committee from the city council have had several meetings this week and have looked the ground over. If lights are to be placed at every street crossing, 650 lights will be necessary. Some of the committee seem to be in favor of this, while others think the city can be lighted with a less number. The city engineer's estimate was 500 lamps.

The Fort Wayne Jenney company are somewhat encouraged at the present state of affairs, as in one of their bids they guaranteed to light the city for $54,000, furnishing all the lamps necessary for satisfactory lighting.

The committee's report will probably be made at Monday night's meeting of the council, and from present indications there will be a bitter fight between friends of electric light and the gas company. Attempts have been made to discourage the electric light enterprise, and a friend of the gas company has been heard to complacently remark that the gas company would light the city for the next three years. It is now supplying light for $70,000 a year. An equal territory can be lighted better with electricity for $43,500 (500 lights at $87). The gas company wants to light the city on contract for $50,000 (same number of gas lamps as now). The light committee thinks that if gas is used, fully 500 more lamps will be required than are in use, without even displacing the vapor lights.

Four or five years ago an ordinance was put through the city council giving a company, formed for that purpose, right to put down conduits for laying electric wires under ground. Nothing has been done in this direction. At last week's session the council repealed this ordinance.

After much talk Indianapolis is in a fair way to have an electrical street railroad. The cable company, known as the Dudley company, to whom a charter was given about a year ago, to lay and operate a cable line on certain streets, with branches to be operated by animal or electric power, have finally given up the idea of operating a cable line giving as a reason that they could not raise the necessary $140,000 per mile to construct a first-class cable road, and also that they had become convinced from what they had seen and learned of electric motors that they presented a decided advantage over cables. The managers of the enterprise say that they have part of their material on the ground and will begin laying track this week. An order has been given a prominent eastern firm for cars of the most approved pattern to be fitted with electro motors. They will use storage batteries to furnish current, which will give each car 10-horse power and run ten to twelve miles per hour at a cost of $2 per day. The same system has been in operation in Berlin for several years past, and is also being successfully operated in St. Louis. The route now proposed covers something over thirteen miles, a part of it over streets and portions of city not readily reached by street cars at present. M.

From St. Louis, Mo.

St. Louis, Mo., June 2.—S. W. Baird has been absent from the city for a few days. He was called to Grand Haven to deliver the oration on Decoration Day. Mr. Baird was formerly manager of the St. Louis Western Electric Light Co

Mr. Atwood, formerly superintendent of the Thomson-Houston station here, has invented a head light for steamboats and railroads. The lamp works splendidly. Its sound construction has been proved by its being repeatedly dropped from a table to the floor. A voltmeter placed on the terminals does not show the slightest difference in the length of the arc. He has also designed an engine to be used in connection with a small dynamo of his design used to furnish current for his focusing lamp.

The northern nave of the exposition building in St. Louis which has been transformed into the grand hall for the democratic national convention and national saengerfest, with a seating capacity of over 16,000, is illuminated by the Heisler system. The first trial illumination took place June 2d. The effect was most beautiful and pleasing. The hall is 350 feet long and 100 feet wide. Sixteen fixtures holding seven 30 candle power lights and eight fixtures holding thirteen 30 candle power lights suspended at a height of about 40 feet over the audience and about 30 feet over the platform, illuminate the main portion of the hall. The effect was so strong that small print could be read on the floor. About 100 brackets and a single drop light are distributed in the aisles and galleries, in which are also placed the lights of the original isolated plant of the building.

Walking down the street the other day while it was raining, your correspondent saw a little puff of steam rising from a taped connection in an electric light wire hanging down in front of a store. Linemen should solder all of their connections; it would be money in their pockets. B.

THE ELECTRIC LIGHT.

The Garden City (Kan.) Electric Light and Power company will erect a new stone and brick station, large enough for its wants, and has awarded the contract to S. M. Keller.

The Fort Wayne Jenney alternating plant at Harlem, N. Y., was recently tested by a disinterested electrician and was found to be furnishing thirteen lights to the horse power.

The Brush company has taken the contract for lighting the British section at the Brussels Exhibition with supply of current for incandescent lamps for exhibitors and restaurateurs. It is also lighting the hippodrome arena with arc lights, and has a 6-light mast at the entrance.

Within the last year the York (Neb.) Gas and Electric company has put a plant in the city. It was organized with a capital of $10,000, and has now burning 300 incandescent and sixteen arc lights. It has twenty-five arc light dynamo, with a 100 horse power engine and boiler. It has now eight miles of wire stretched throughout the city.

The contract for the buildings of the Jenney Electric Light company's station at Saginaw, Mich., calls for their completion by the 10th, and the company expects to have the new plant in operation within a week thereafter. The company will put in a plant of about double the capacity of the present plant for furnishing arc lights and will put in machinery for running 800 incandescent lights.

Lightning struck the Elizabeth postoffice last week and set fire to the building. Three attempts were made to ring the fire alarm, but all failed, owing to the electric disturbance. The fire was extinguished by pouring water into the postoffice from the floor above. The operators in the Western Union office adjoining were driven from their instruments by the electric fluid and the room for a moment was a blaze of fire. The electric lights throughout the city were put out by the shock.

The building in Head place, in which was situated the Boston Edison electric light plant, took fire at an early hour Saturday morning. The firemen soon had the fire under control, but not until the entire upper portion of the Edison works was completely destroyed. The second floor was used as the dynamo room, and here the fire started, it is supposed in an equalizer box. Several employes had narrow escapes. The burning of the station cuts out the Edison system from the entire city. The Globe Theatre, Hollis Street Theatre, Adams House, Clark's Hotel, Park's Hotel, and Young Men's Christian association buildings are lighted from this source. The loss is said to be about $50,000.

He Didn't Appreciate Science.—Mr. Couleur-de-Rose (enthusiastically)—"Wonderful period we are living in! wonderful! Look at the progress we are making in the arts and sciences, everything." Mr. Go-slow (doubtfully)—"Y-e-e s." "Take electricity, for instance." "I prefer not to take it. Somebody takes it nearly every day in New York and elsewhere, through the electric light wires, and they never take anything afterward, not even their breath." "See what natural gas is doing for us!" "I see accounts of its doings in the papers. It blows up houses and factories and doesn't even spare cathedrals. What a power, too, dynamite has become!" "It has indeed. It had enough power to blow up two trains in collision the other day, and kill a lot of passengers. So if you travel and miss being blown up on a train, you are liable to be if you stop in a a city that uses natural gas. Escaping that, you may get your quietus from an electric light wire that drops on you in the street. Science and discovery be hanged!" Couleur-de-Rose walked away, quite disgusted with a man who couldn't appreciate the advancements of science.—*Texas Siftings*.

In the Brooklyn common council last week Alderman Coffey moved that the legislative committee be instructed to go to Albany and urge the governor to veto the Edison electric light bill, which confers a franchise on the company to operate in Brooklyn without the consent of the local authorities. Alderman Smith thought the governor should be urged rather to sign the bill, as the company was ready to supply light at a cost of 25 per cent. less than is paid at present. The company had gone to Albany because a hearing had been refused it at home. Alderman Pickering denounced the insinuations made to the effect that if the Edison company wanted a franchise from the aldermen it would have to buy it. For his part, when such suggestions were thrown out, he would vote against a project even if it were a benefit to the city. Alderman Coffey's resolution was adopted.

A special dispatch from Indianapolis dated the 5th, reads as follows:

"The Brush Electric Light company's suit against Owen Pixley & Co., of Indianapolis, which involves the entire arc system of electric lighting, was dismissed by Judge Gresham to-day for want of equity. Although Owen Pixley & Co. are the nominal defendants, the real defendants are the Jenney Electric Light company, of Fort Wayne, who put in the plant in controversy, and all others who use the arc system. Judge Gresham's opinion is as follows:

"1. The invention is shown in the patents 212,183 and 219,208, but in 212,183 the examiner held that Brush's claims were too broad. The decision was acquiesced in, and the invention which was there described, claimed, and rejected is now claimed in the patent sued on. The rejected invention was dedicated to the public by acquiescence in the ruling of the examiner, and cannot be claimed in a subsequent patent against others who meantime entered the field and used the rejected invention.

"2. The patent in suit is limited to solenoids and cores mechanically opposed, and it does not include the common or electro-magnet, and thus construed the patent sued on is not infringed by the defendants."

THE ELECTRIC MOTOR.

The Sprague company have recently received orders for a number of motors to be shipped to Paris. They report large sales of standard motors for the last two weeks.

The street railway company at Adams, Mass., is planning to introduce electric motors on the road, and do away entirely with horses. The matter has not been definitely settled, but the project will probably be carried out.

There are four and a half miles of electric road in operation at San Diego, half a mile in construction, and eighteen and a half miles projected. The San Diego Electric Rapid Transit Street Car company has asked for a franchise to construct feeders on Sixth and Arctic streets.

A. H. Emery, agent on the Pacific coast for the Julien system of electric motor roads, has been in Fresno, Cal., recently, on business connected with the proposed electric road. He estimates the cost of the four miles of road at $50,000. An extension of sixty days on the franchise has been granted, and before the expiration of that time the road will either be begun, or the project given up.

The Lafayette, Ind., and Davenport, Ia., street railroads, which are being equipped for electric service by the Sprague Motor company, are both approaching completion. The Lafayette road is to be extended half a mile farther than at first intended. A. D. Lundy, the Electrical Engineer of the Sprague company, has associated with him at Davenport, G. H. R. Preble, and at Lafayette, J. M. Atkinson, both gentlemen of experience in electrical work.

The New York *Sun*, of May 31st, says: "The combine against the Fourth avenue electric motor weakened yesterday, showing but eleven votes to fourteen for the motor, public convenience, and honesty. It seems there are still aldermen familiar with recent history, and aware that public opinion is a more dangerous thing to have a collision with than the stores of sulphuric acid which bring such horror to the lily soul of Alderman Dowling."

With the New York aldermen's motives the country has nothing to do, but the facts are notoriously incorrect when they assume to deny that, the question of expense aside, the electric street car is in speed, safety, readiness of handling, quietness, and comfort, immeasurably superior to any other present means of street railway propulsion. That much the country already knows.—Providence *Journal*.

A man on Sixth avenue, New York, claims to have just perfected a discovery by which he can run a two-horse power motor by the electrical current from a cell battery at a cost of thirteen cents per week. He has made himself sick by his intense devotion to working out the problem, but as soon as he gets well again he is going to exploit his discovery upon a startled world. If things keep going on in that way the time may come when it will be cheaper for a man to run a motor than not to do so, even if he has no use for it.

THE TELEPHONE.

The Bell Telephone company have asked permission of the city authorities of Rochester, N. Y., to begin the work of undergrounding their circuits.

"How," asks the New York *Sun*, "does Hon. Melville Weston Fuller stand on the telephone question?" He stands all right. He is in favor of making the girls at the central office answer every call promptly and not ring off until you are done with the 'phone.—*Dayton Journal*.

The Ohio Valley Telephone company is laying pipes from the rear of the telephone exchange, on Green street, to Eighth and Main streets, Louisville, Ky. The company will place all the wires in the central part of the city underground, doing away with a great many telephone poles. The business of the company has increased so materially during the past few years that the present poles are almost inadequate to sustain their weight.

Alwin Hempel of Dresden, has invented a micro-telephone station, in which the microphone is so extremely sensitive that it reproduces the most softly whispered tone. The reproduction of the spoken voice is so exceptionally loud that even deaf people can avail themselves of Herr Hempel's appartus. The microphone can also be employed for the transmission of music. More than 100 telephones can be connected with a single one of these microphones. Herr Hempel is in possession of a testimonial from Prof. Dr. Kohlrausch, one of the first authorities upon electro-technical matters in Europe, who states that he knows of no microphone station which works better than that patented by Herr Hempel.

Glasgow has a system of automatic telephone call-boxes. There are seventy-six of the boxes scattered about the city, and every subscriber has a key to them. A non-subscriber wanting to use them must first ring up the exchange and ask if the connection he desires can be made. If it can, he drops the fee, which is either three pennies or six, according to the distance he wants to talk, into a hole in the box. The pennies as they fall break a circuit and ring a bell at the central office. When the bell has rung the required number of times the central office makes the connection. At the end of the three minutes allowed for conversation the connection is broken automatically. The average time taken to put two persons in telephonic communication in Glasgow is thirty-five seconds, in Birmingham forty, in Liverpool thirty-two, and in Dundee twenty. This was ascertained from the results of ten calls in each town.

A St. Louis dispatch says: The Bell Telephone company was a defendant in a case in the police court for violating the ordinance prohibiting telephone companies from charging more the $50 a year for use of an instrument. Judge Cady held that the ordinance was legal and all right, and fined the telephone company $300. The directors of the St. Louis Bell Telephone company failed to hold a meeting Saturday as they previously announced they would, and Secretary Durant stated that the meeting would not be held until next week. This meeting is of interest to the greater portion of the citizens of St. Louis, inasmuch as it is expected to decide the question whether the company will give telephonic service at $50 annual rental instead of $100 as charged before the passage of the reducing ordinance by the municipal assembly, or whether it will carry out its threats to take out the instruments and close the exchange. It is believed that the company will decide to take the latter alternative.

Judge Rombauer, of Missouri, has reversed the decision in the case of the city of Hannibal vs. the Missouri and Kansas Telephone company on appeal from the Hannibal Court of Common Pleas. In 1879-'80 the Hannibal Telephone company was granted the right by ordinance to erect poles along Broadway, Hannibal, and afterward transferred its franchise to the defendant. In May, 1886, the Hannibal city council passed an ordinance requiring the removal from the sidewalks of the telephone posts and abutments. The ordinance not being complied with, the city authorities filed a complaint before the recorder, and the telephone company was adjudged to pay a fine. The Court of Common Pleas affirmed the recorder, and the company appealed on the ground that the recorder's court had no jurisdiction and that when the poles are once located an alteration in their location cannot be arbitrarily made without some cause showing a necessity for the alteration, and that no such cause had been shown.

The following statement from a St. Louis merchant will by accepted as sound by most telephone companies with the exception of that which relates to rates: "I am in favor of reducing the rental of telephones, but no matter what they cost I tell you the modern business man can not afford to be without them. Any merchant who dares to try to get along without a telephone in his establishment is making a mistake. The rent is pretty high, but if you have had experience with private telephones you will not care to make very loud complaint. We had three private telephones, which we gave up after the Supreme Court decision in favor of the Bell Telephone company. Each of those telephone boxes costs us $20 a year for rent. The wire was our own, and we paid for stretching it. The wire, etc., from our Olive street to our Broadway house cost us $25, and then we had to pay $25 more per year for keeping it in repair. After awhile we put in a wire between Olive street and the Fourth street restaurant. The wire and stretching cost us $20, and the repairs cost us $15 a year. After that we made connection with our bakery, and added an extra amount to the annual repairs on our wires. The wires and all cost us, I think, about $100, then we paid $60 for rent and $55 for repairs, so you see our private wires came high, but we had to have them. The public telephone is just as good for all business purposes as a private one, and if the rent were $50 a year I think it would be about right."

THE TELEGRAPH.

The seventh annual meeting of the Association of Railway Telegraph superintendents will be held at the Murray Hill hotel, New York, at 10 a. m., July 11th.

The Fort Worth and Denver Telegraph company's lines, extending from Fort Worth and Pueblo, have been acquired by the Western Union company. The line is over 600 miles long and has been a profitable property. It is the only direct line from Texas to Denver and other Colorado points.

The Central and South American Telegraph company's surveying staff is now engaged in locating its proposed telegraph line across the Isthmus of Panama, the company having secured from the United States of Colombia the necessary concessions for operating a line.

The case of the city of St. Louis against the Western Union Telegraph company, a proceeding involving the right of the city to collect licenses at a rate of so much per pole, has been transferred from the state Circuit court to the United States Circuit court, upon application of the telegraph company.

The Pacific railroad telegraph bill favorably reported to the senate from the inter state commerce commission is the house (Anderson) bill, says a Washington dispatch, amended by striking out the word "construct." It requires the subsidized roads to maintain and operate public telegraph lines, but the effect of the amendment is to permit their acquisition by purchase or in any other way the companies see fit.

Advices which have reached Ottawa are to the effect that the lords and commissioners of the admiralty have sanctioned the employment of the Equeria to survey the route for mail steamers and laying the submarine cable between British Columbia and Australia. Admiral Fairfax, commander of the Australian squadron, has received orders to use the Equeria for the work. It is likely to occupy three years. It will cover an expanse of water 200 miles wide for the entire distance. It is impossible to describe the precise route, but it will commence from some point on the east coast of Australia and proceed via the extreme northern coast of New Zealand, thence to British Columbia, passing Fiji islands and connecting with the Canadian Pacific.

A report gained circulation last week that the president had the White House connected by special wire with St. Louis, and that his intention was to keep in constant communication with his friends in the convention. The president denied the story and said he had made no arrangement about getting news from the convention, and did not intend to; that he supposed he would have to depend on the charity of his friends if he got any more information than other people. A telegraph operator is kept in the White House all the year round, but his wires are only connected with the general office of the Western Union in Washington, and he is employed simply as a convenience when haste is required in the transmittal of official telegrams. Both press associations have for years manifolded their reports received from the national conventions and have sent copies to the president for the purpose of keeping him informed of the proceedings.

A dispatch from St. Thomas, Ont., says: "A representative of the Order of Railroad Telegraphers has been making a tour over the Michigan Central railway for the past few days inducing operators to become members of the association, and as a result nearly every operator of the road has joined the order. The object of the association is for mutual protection, every member pledging himself that he won't teach the art to others. Superintendent Morford, however, is opposed to the brotherhood, and on Saturday telegraphed an order to all operators requesting them to at once withdraw from the association, intimating that unless they did so they would be relieved from further duty. The order created great excitement among the operators, many of whom say they will not withdraw but will stand firm to the brotherhood. P. G Bromley, at Tilsonburg, for many years past an old operator, joined the association, and on being requested by Mr. Morford to withdraw refused and has been discharged. It is difficult to say how the affair will terminate."

Elias R. Bowen, receiver of the Great Western Telegraph company, recovered a verdict for $875 in Judge Clifford's court, in Chicago last week, against A J. Hoagland, who was a stockholder in the company. The result of the trial affects 2,000 stockholders. The Great Western Telegraph company being insolvent, Elias R. Bowen was appointed the receiver. He found that the assets could not satisfy the creditors. Application was made to Judge Tuley and a decree was entered assessing the 2,000 stockholders 35 per cent. of the par value of each $25 share of stock. About fifty suits were begun against individual stockholders. Hoagland's is the first tried, and the $875 verdict represents 35 per cent of 100 shares of stock. He had paid $1,000, but many other stockholders have not paid a cent. The indebtedness of the company amounted to $400,000. Thomas Sutherland, who is prosecuting the suits against the stockholders, said: 'The facts are pretty near as Judge Sherwood of the Missouri Supreme court stated them. Judge Sherwood said: "There have been many devices, many schemes, many cunningly devised transactions where men have sought to receive every benefit and yet shirk every burden incident to the position of a stockholder. But such devices have generally come to naught. The courts have been sedulous in their endeavors to bring about such a result." This case of Hoagland having resulted in the receiver's favor, the other stockholders will be proceeded against, and the creditors of the company who have waited fourteen years for their money will doubtless receive it.

Miscellaneous Notes.

A recent novelty is the employment of electricity instead of percussion caps for firearms. The spark is produced as in the case of gas lighters. It is said that by this means a more powerful explosive than gunpowder can be employed.

At the meeting of the American society of Mechanical Engineers at Nashville, Mr. Barrus read a paper describing an electric apparatus which he had used to mark upon a strip of paper the strokes of an engine and the seconds of a clock simultaneously for comparison.

The Cincinnati Press club has established permanent quarters during the centennial at the Exposition buildings, and will dedicate them Saturday evening, June 9th. The committee is composed of Milton A. McRae, chairman, F. B. Wright, N. P. Runyan, Howard Saxby, A. Fleming.

In the injunction suit of the Washburn & Moen manufacturing company and J. L. Ellwood against the St. Louis Wire Mill company a motion was argued last week at Springfield, Ill., before Judge Allen in the United States Circuit court on the part of the defendants for leave to file a cross-bill and for an injunction to restrain the plaintiffs from bringing any more suits against the users of the products of the defendant pending this litigation. The whole day was consumed in the arguments. The court took the motion under advisement.

Mr. Edison has recently applied his perfected phonograph in several curious ways. He has made a talking doll in which the speaking is effected by a tiny phonograph and a little electric motor. He is also credited with inventing a clock which by the aid of a phonograph announces the hours of the day, thus doing away with striking apparatus. Mr. Edison is quoted as saying: "It is the intention of the company in which I am interested to make a regular business of the publication of music for use upon the phonograph, and already I have in view an enterprising publisher in New York to handle it for me and place it on the market. Of course, this will not be printed music, but merely impressions upon the wax cylinders of the phonograph, so that the owner of an instrument can have a repertoire of the latest songs at a nominal price of twenty cents each If he wishes to hear an andante from Beethoven in his parlor all he has to do is to adjust his cylinder. These cylinders are practically indestructible. They can be used times without number, and when the owner of the phonograph becomes tired of a particular composition he can have it removed from the cylinder and another substituted for it."

Personal Paragraphs.

George F. Porter of the Faraday Carbon company of Pittsburgh is looking up business in the west.

W. E. Sharpes of the Edgerton Motor company of Philadelphia, has been in Chicago a few days.

George A. Mayo, of Belmont, N. Y., inventor of the Mayo dynamo, was in Chicago for several days this week.

Willard L. Candee, general manager of the Okonite company of New York, was in Chicago this week, and has gone farther west.

E. C. Sims, resident representative of the Armington & Sims Engine company, is recovering from a long and severe siege of illness.

J. A. Wetmore, of the Okonite company, was in Chicago a few days last week. As usual he had plenty of orders booked as the result of his trip.

Walter K. Freeman, of the Fort Wayne Jenney Electric Light company, was in Chicago Monday and left the same evening on an extended business trip.

George Cutter, of the Chicago office of the Thomson-Houston company, has been bereaved by the loss of his mother by death. Assurances of sympathy will be extended by a wide circle of friends.

Thos. D. Lockwood, of Boston, returned to Chicago Saturday last from a trip to Kansas City and Omaha and left the same evening for Boston. Mr. Lockwood speaks very highly of the Kansas City and Omaha telephone exchanges.

F. W. Cushing, superintendent of the Chicago Arc Light and Power company, has returned from a ten weeks' tour through New and Old Mexico and Southern California. His health, which was broken by severe and unremitting application to work, has been completely restored.

The death is recorded of F. W. Day, late superintendent of distribution of the Columbus Gas Light and Coke company. Mr. Day was a young man—about 28 years of age—but the promise of his future was great. He was a strong believer in the electric light, notwithstanding he was bred a gas man.

F. E. Degenhardt, Chicago representative of the Standard Underground Cable company of Pittsburg, will remain their representative in this city for some years to come by virtue of a contract recently made between party of the first part and party of the second part, etc. Mr. Degenhardt came to Chicago three years ago and in that time has built up a trade that warranted the company in making an effort to retain his services at a salary of generous proportions. The company is to be congratulated on retaining the services of as valuable a man as Mr. Degenhardt, and on the other hand the latter is to be congratulated on having his services so handsomely recognized.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	375	400
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	27	28
Missouri and Kansas	70	71

Business Mention.

The Western Electric company of Chicago has moved into the south extension of its building.

Under the date of May 17th, F. B. Thurber, of the wholesale grocery house of Thurber, Wyland & Co., of New York, says that the elevator service, recently installed in their place, by the Sprague Electric Railway and Motor company, "is the best and cheapest in the world."

Chas. A. Schieren & Co., of New York, report sales of their leather link belting to the following electric light companies, for use on dynamos: Western Edison Electric Lighting company, Chicago, Ill.; United States Electric Lighting company, Washington, D. C.; Burlington Gas Light company, Burlington, Vt.; Bethlehem Electric Light company, Bethlehem, Pa.

Among other recent sales the Standard Underground Cable company of Pittsburgh report the following: Western Union Telegraph company for Pittsburgh, Pa., 5,120 feet of 61 wires bunched, 14 B. & S. gauge; Electric Improvement company, San Francisco, Cal., 6 miles of number 6 weatherproof wire, 2 miles of which go to San Jose, Cal.; 5,000 feet of number 4 B. &. S. gauge electric light wire to The Newark, Ohio, Electric Light company; 1,200 feet of 50 wires number 22 B. & S. gauge to Quincy, Ill., for the Central Union Telephone company.

Electrical Patents.

Issued May 29, 1888.

383,436. Retouching Device. George F. Card, Covington, Ky.

383,439. Electric Alarm Clock. Edward J. Colby, Chicago, Ill.

383,444. Galvanometer. Rookes E. B. Crompton and Gisbert Kapp, Chelmsford, County of Essex, England.

The second claim reads:

"2. In an instrument for measuring electromotive force or current, the combination of the controlling electro-magnet or electro magnets having a core or cores small enough to be easily saturated, with poles extended beyond the exciting coil or coils toward the needle, so as to minimize the direct action of the magnetizing coil or coils upon the needle."

383,450. Printing Telegraph. Samuel V. Essick, Brooklyn, N. Y.

383,464. Thermo-Electric Generator. Robert J. Gulcher, Berlin, Germany.

Claim 6 reads:

"6. The combination, with an external hollow thermo-electric element, of a second internal element provided with a central passage for gas, and a burner hole common to both elements."

383,484. Manufacture of Filaments for Electric Incandescent lamps. James W. Packard, New York, N. Y.

383,485. Electric Punch Register. Augustus C. Palmer, Utica, N. Y.

383,495. Test-Circuit for Multiple Switch-Boards Charles E. Scribner, Chicago, Ill.

The object of the invention is to enable the operators at different boards to determine whether any line is busy when said lines are connected with the ordinary spring-jack switches, and without the use of special test wires and special connections therefor. Claim 4 follows:

"A subscriber's circuit extending from ground at the subscriber's station through the springs of a series of switches on different sections of a multiple switch-board and an annunciator back through the insulated frames or test pieces of said switches, and thence back to the subscriber's station, the portion of the circuit connecting with the frames or test-pieces being normally open at said subscriber's station and in combination with a plug which, being inserted in a switch at either of the boards, opens the metallic circuit at said switch."

383,502. Apparatus for Lighting Railway Cars by Electricity. Illius A. Timmis and Stanley C. C. Currie, London, County of Middlesex, England.

Claim 5 is given:

"The combination, of the generator, the charging circuit, the storage batteries and lamps in multiple arc in the charging circuit, their electro-magnet circuit controllers, the actuating mechanism thereof, and a controlling circuit of which one of the charging wires constitutes a portion."

383,520. Production, Transmission and Distribution of Electric Currents. Charles E. Fritts, New York, N.Y.

The first and last claims are as follows:

"1. An organized system for the production, transmission, and distribution of electric currents, consisting of the combination of apparatus for automatically producing a suitably varying current and one or more external or working circuits connecting the opposite poles of the current producing and varying apparatus, said circuits being inductively connected to the poles through electrical condensers or devices which prevent the actual passage of the initial current from the poles over the lines or circuits, but which transmit a corresponding amount of electrical energy over the circuits by virtue of induction through said devices from both of said poles.

32. "The combination of a sectional line consisting of sections inductively connected through condensers, self-regulating apparatus for automatically supplying suitably varying currents as needed on said line and properly connected thereto, and suitable resistances in the sections, having the maximum section resistance properly adjusted to determine the volume of current flowing over the line."

383,536. Thermo-Electric Apparatus for Controlling the Temperature of Water in Pipes. Edwin A. Newman, Washington, D. C.

383,548. Electric Battery. Edward A. Wildt, Long Island City, N. Y.

383,560. Secondary Battery. Camille A. Faure, Paris, France.

The last claim is given:

"3. The process of construction of a secondary battery, which consists in first preparing the active material as a paste, then combining the same with the electrodes, and then placing the same in a battery cell containing an electrolytic liquid, in which such active material is practically insoluble."

383,561. Propelling Vehicles by Electricity. Camille A. Faure, New York, N. Y.

The claim reads:

"The method herein described of operating a vehicle propelled by an electric motor supplied with a current from a secondary battery carried by the vehicle, consisting in braking the vehicle and returning current to the secondary battery to recharge it by decreasing the electromotive force of the battery until the counter electromotive force of the motor exceeds it when the vehicle is on a down grade or slowing down."

383,562. Secondary Battery. Camille A. Faure, New York, N. Y.

383,563. Telephone Call-Bell System. Frank E. Fisher, Detroit, Mich.

Claim 2 reads:

"In combination with a line wire, two or more telephone stations connected with said line wire, and each having its bell circuit normally open, and a continuous current electric motor situated at each telephone and adapted to close the bell circuit thereof, and a second line wire, not connected directly with the telephones, said motors being connected in multiple arc with said two line wires."

383,564. Armature for Electric Motors. Frank E. Fisher, Detroit, Mich.

383,565. Dynamo-Armature. Frank E. Fisher, Detroit, Mich.

383,566. Annunciator. Frank E. Fisher, Detroit, Mich.

383,567. Armature for Dynamos. Frank E. Fisher, Detroit, Mich.

383,575. Manufacture of Secondary Batteries. Rudolph M. Hunter, Philadelphia, Pa.

Claims 1 and 9 follow:

"1. The method of forming an element for a secondary battery, which consists in placing hardened pieces of active material in holes or perforations in a metal plate of ductile material and then bending the edges of said plate adjacent to the active material pieces partly over them, to hold them in place and leave a large area of the active material exposed."

"9. The method of making perforated plates for an element of a secondary battery, which consists in, first, perforating a plate of lead or other suitable metal or combination of metals of uniform thickness, and then subjecting it to pressure to reduce the thickness of the metal between the apertures and force the edges of the perforations to spread inwardly, to form overhanging lips without touching each other, and adapted to hold the active material in place."

383,583. Electro-Magnetic Register. James F. McLaughlin, Philadelphia, Pa.

383,602. Carbon Conductor for Electric Lamps. Hans Joachim Von Metzradt, New York, N. Y.

The invention consists of a carbon for galvanic batteries, composed of one part coke, one part of anthracite coal, one part of gas house carbon, and one-sixth silicate, molded together.

383,605. Apparatus for Testing Electric Circuits. Alden D. Wheeler, Hyde Park, Mass.

383,611. Electric Cigar Lighter. Reginald Belfield, Pittsburg, Pa.

383,616. Incandescent Lamp Henry M. Byllesby and Philip Lange, Pittsburg, Pa.

383,617. Armature for Dynamos and Motors. Henry M. Byllesby, Pittsburg, Pa.

Claim 1 reads:

"In an electric machine, the combination, with the armature core and wires wound upon the face thereof and down upon the ends, of overhanging clips of glass beneath which the wires upon the ends of the armature pass."

383,618. Synchronizing Device for Alternate Current Dynamos. Henry M. Byllesby, Pittsburg, Pa.

The invention relates to a method of constructing and organizing electric generators for the purpose of obtaining synchronism in their movements.

383,619. Armature for Dynamos and Motors. Henry M. Byllesby, Pittsburg, Pa.

Claim 4 follows:

"The combination, in an armature for electric machines built up of alternate sheets of soft iron and insulating material, of one or more heavier plates intermediate in the series, longitudinal strips or lugs secured thereto, and binding strips secured at their respective ends to adjacent longitudinal strips"

383,620. Combined Alternate Current and Storage System of Electrical Distribution. Henry M. Byllesby, Pittsburg, Pa.

Claim 1 follows:

"The combination, with a system of electric conversion and distribution, of a source of alternating electric currents for supplying the same, a source of direct electric currents, a storage battery charged from the last-named source, and a rheotome or current-controller through which the battery may be connected with said system."

383,621. Alternate Current and Storage System of Electrical Distribution. Henry M. Byllesby, Pittsburg, Pa.

The invention relates to an organization of circuits and apparatus whereby a storage battery may conveniently be employed in connection with a secondary system of electric distribution and conversion for various useful purposes.

Claim 5 reads:

"The combination, with a source of alternating, intermittent, or pulsatory, electric currents and a work circuit supplied therefrom, of a storage battery, a current rectifier through which currents are delivered from said source to said battery, a system of secondary distribution operated by currents from the generator, and means for connecting said storage battery with the work circuit through said rectifier."

383,622. Alternate Current and Storage Systems of Electrical Distribution. Henry M. Byllesby, Pittsburg, Pa.

The first claim reads:

"The combination of a source of electricity, a storage battery, means for connecting the same with the source, a system of intermittent, pulsatory, or alternate current electric distribution, and a rheotome through which the storage battery is connected with the supply conductors of said system."

383,623. Combined Alternate Current and Storage System of Electrical Distribution. Henry M. Byllesby, Pittsburg, Pa.

383,640. Storage Battery Plate. Charles D. P. Gibson, New York, N, Y.

The first claim is given:

"A storage battery plate consisting of two sheets of metal, each formed with openings, as described, the metal around said openings being forced outward on each side of the plate, so as to form projections, and placed together, with the projections on one plate touching the projections on the other plate."

383,647. Switch for Adjustable Resistances. Philip Lange, Pittsburg, Pa.

Claim 4 reads:

"In a circuit controlling switch, the combination, with the contact plates and lever, of a contact spring carried by the lever and pressing against said plates, consisting of a looped band of resilient metal having its ends projecting toward each other and fastened to the lever."

383,648. Apparatus for Connecting Alternate Current Dynamos. Philip Lange, Pittsburg, Pa.

The invention relates to an organization of apparatus and circuits for connecting alternate current electric generators in multiple arc.

383,649. Voltmeter. Philip Lange, Pittsburg, Pa.

383,651. Governor for Electric Motors. Richard H. Mather, Windsor, Conn.

383,655. Circuit Closing Device for Electric Clocks. Chester H. Pond, Brooklyn, N, Y.

383,657. Bobbin for the Field Magnets of Dynamos. Albert Schmid, Allegheny, Pa.

383,658. Brush-holder for Electric Generators. Albert Schmid, Allegheny, Pa.

383,659. Armature for Dynamos. Albert Schmid Allegheny, and Henry M. Byllesby, Pittsburg, Pa.

The last claim—the fifth—is given:

"In an armature for electric machines, a core, inductive wire wound upon the face thereof, a layer of insulating material covering said wire, plates secured to the respective ends of the armature, and flanges upon said plates projecting over the wire and its insulation."

383,661. Circuit Controlling Apparatus for Electric Lighting Circuits. Oliver B. Shallenberger, Rochester.

383,662. Coupling of Alternate Electric Current Generators. Oliver B. Shallenberger, Rochester.

The invention consists in providing a self-induction or reactive coil, which is preferably adjustable for the machine, which is liable to have less self-induction than the other.

383,663. Armature for Dynamos. Oliver B. Shallenberger, Rochester, Pa.

The invention consists in forcing the "clips" for retaining the armature windings in the following manner: A frame of metal—say brass—receives a wooden block, which constitutes an inner lining and beneath which the wire is passed. This frame and block are secured to the armature by screws.

383,664. Armature for Electric Machines. Oliver B. Shallenberger, Rochester, Pa.

383,665. Indicator for Electric Circuits. Oliver B. Shallenberger, Rochester, Pa.

The invention consists in introducing into the circuit of the voltmeter an opposing electromotive force, the amount of which is proportional to the current delivered to the work circuit, and therefore approximately proportional to the rise and fall of potential in transmission.

383,666. Apparatus for Detecting Ground Connections in Electric Circuits. Oliver B. Shallenberger, Rochester, Pa.

The object of the invention is to provide means for detecting and locating faults in conductors employed in systems of alternate current electric distribution, and relates especially to circuits wherein metal-covered underground conductors are used.

Claim 2 follows:

"The combination, with a source of alternating electric currents and underground metal-covered lines leading from the respective poles thereof, of two electric converters, means for placing the same in circuit between the the respective lines and the earth, and indicating devices connected if the secondary circuits of the respective converters."

383,667. Method of Indicating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

The invention relates to a method of indicating the current upon any given circuit; and the object is to provide convenient means for measuring and determining at the central station the difference of potential upon the work circuit.

Claim 1 follows:

"The hereinbefore described method of indicating the difference of potential upon an electric circuit, which consists in introducing in the circuit of an indicator deriving currents from the said circuit an opposing electromotive force which is approximately proportional to the current in the work circuit."

383,668. Electrical Indicator for Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

Claim 1 is given:

"The combination of an indicator acted upon by variations in alternating, intermittent, or pulsatory electric currents to indicate such currents two self-induction devices and two resistances respectively in branch circuits spanning one of said self-induction devices and said indicator, and the other of said induction devices and the indicator."

383,669. Electrical Indicator. Oliver B. Shallenberger, Rochester, Pa.

The last claim is given: "4. An electric indicator for alternating, intermittent, or pulsatory electric currents, consisting of an indicating device affected by such currents, and two or more self-inductive devices having different coefficients of self-induction in circuit therewith."

383,670. Electrical Indicator. Oliver B. Shallenberger, Rochester, Pa.

The object of the invention is to provide convenient, effective and reliable means for determining whether the difference of potential existing between two given points in an electric circuit supplied with alternating, intermittent or pulsatory electric currents rises or falls below a normal point, and the amount of divergence therefrom.

383,671. Electrical Indicator. Oliver B. Shallenberger, Rochester, Pa.

Claim 6 follows: "An indicator for periodically variable currents, consisting of two circuits of approximately constant specific resistance having points of equal normal difference of potential, a coil of self-induction included in one of said circuits, and an indicator connected between the points of equal potential."

383,672. Method of Indicating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

Claim 4 is as follows: "The hereinbefore described method of indicating the difference of potential between two points in an electric circuit for alternating, intermittent or pulsatory electric currents, which consists in establishing a difference of potential at the terminals of a coil of high self induction which derives current from that circuit and in adding the difference of potential at the terminals of an adjustable resistance connected in the same circuit."

383,675. Manufacture of Incandescent Electric Lamps. Edward P. Thompson, Elizabeth, N. J.

The invention consists in providing two independent arms for each leading-in wire. These extend through the outer wall of the lamp to the joint of the corresponding end of the filament. These wires may be independently included in an electric circuit by connecting their respective ends with a generator or other source of electricity.

383,676. Evacuating Electric Lamps. Edward P. Thompson, Elizabeth, N. J.

383,677. Galvanic Battery Fluid. Hans J. Von Metzradt, New York, N. Y.

383,678. Electric Meter. Geo. Westinghouse, jr., Pittsburg, Pa.

The invention relates to apparatus for registering the quantity of electricity used for operating translating devices or consumed in any given circuit.

The last claim runs:

"5. The combination of a revolving plane, spheroidical roller in frictional contact with the face thereof, guides for retaining the axis of the roller in a plane perpendicular to the axis of revolution of said plane, and mechanism actuated by electricity for moving said axis in said perpendicular plane."

383,679. Mounting Armatures of Dynamos. Geo. Westinghouse, jr., Pittsburg, Pa.

The invention relates to a method of mounting the armature so as to relieve the bearings of undue friction.

383,680. Electric Meter. Geo. Westinghouse, jr., and Philip Lange, Pittsburg, Pa.

The invention relates to apparatus employed for registering the quantity of electricity used for operating translating devices or consumed in any given circuit.

383,706. Galvanic Battery. Harry B. Cox, Cincinnati, Ohio.

383,725. Electrical Needle Annunciator. William E. Gill and Rudolph Segerdahl, Chicago, Ill.

The claim is given:

"In electrical needle annunciators, a slotted restoring bar, in combination with weighted levers, the weighted ends of the weighted levers being in the slots, and being restored thereby to their normal position."

383,734. Insulator for Electrical Wires. Frank E. Keyes, Peterborough, N. H.

383,756. Crawler for Electric or Other Conduits. Henry G. Morris, Philadelphia, Pa.

383,757. Method of Filling Secondary Battery Plates. Henry G. Morris and Pedro G. Salom, Philadelphia, Pa.

383,770. Underground Conduit and Grip for Electric Railways. Elias E. Ries and Albert H. Henderson, Baltimore, Md.

383,771. Mail Conveying Apparatus. Alfred D. Saunders, Brooklyn, N. Y.

383,786. Electric Apparatus for Winding Clocks. Mariano Viau, Bilbao, Spain.

383,794. Electric Smelting Bottle. Charles T. Brown, Chicago, Ill.

383,795. Device for Preventing Incrustation in Steam Boilers. William B. Bull, Quincy, Ill.

383,832. Current Collector for Electric Machines. William Stanley, jr.

383,843. Relay. John E. Watson, Louisville, Ky.

383,844. Overhead Conducting System for Electric Railways. Grandville T. Woods Cincinnati, Ohio.

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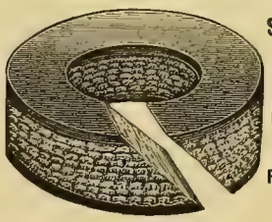

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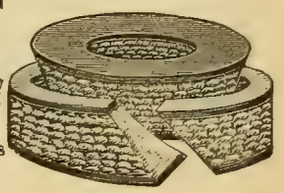

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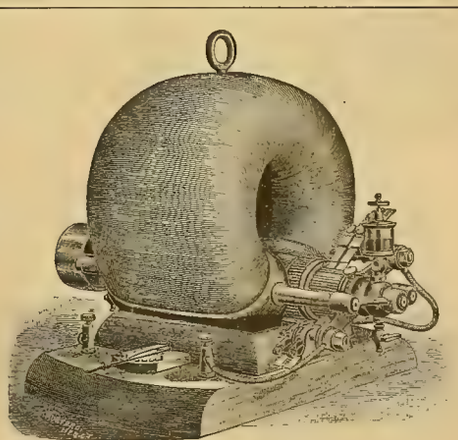

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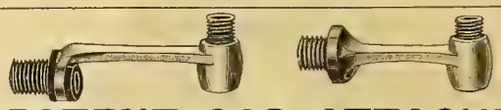

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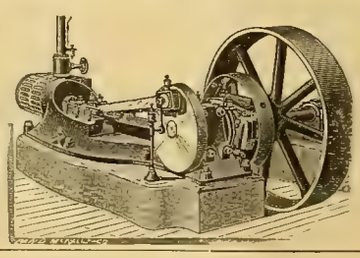

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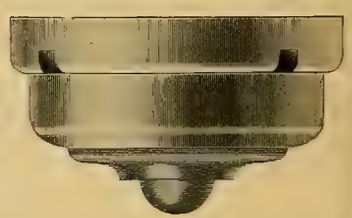

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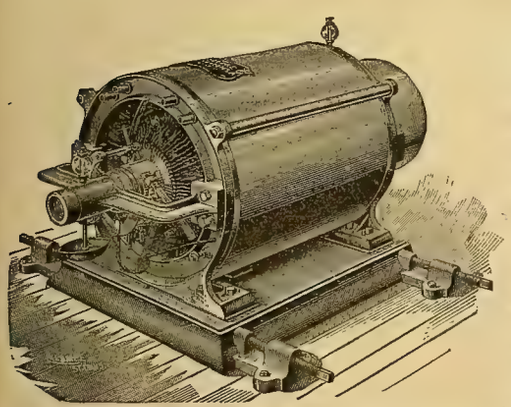

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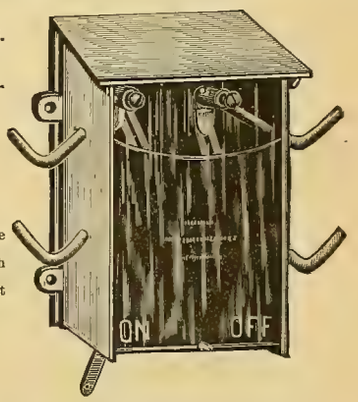

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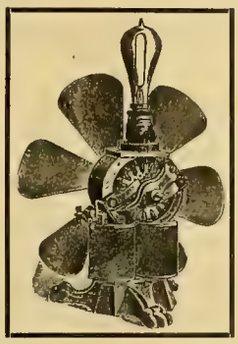

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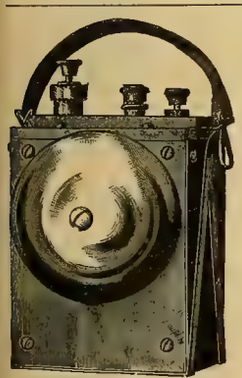

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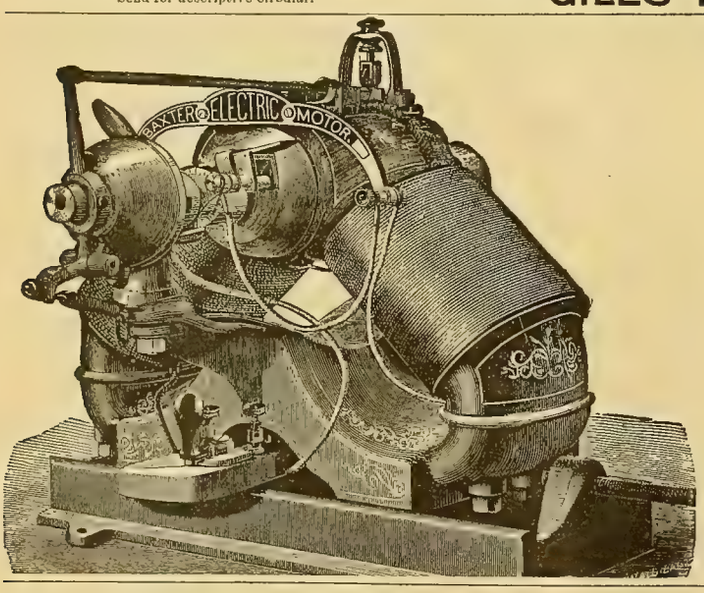

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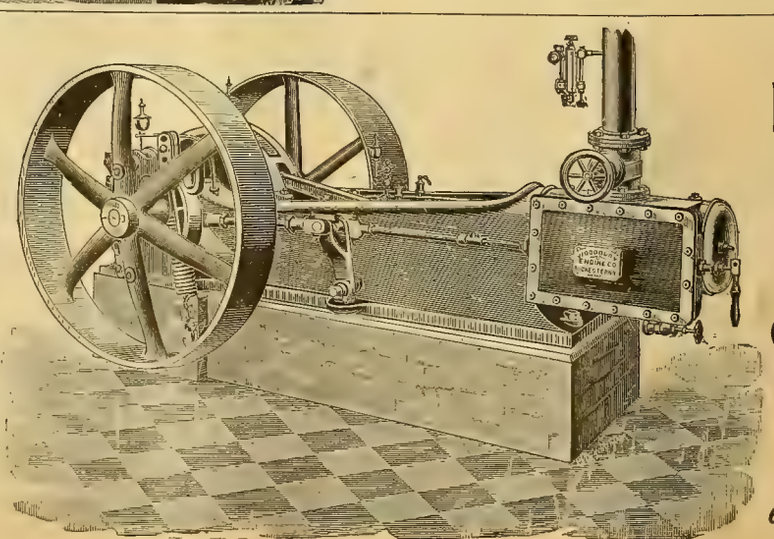

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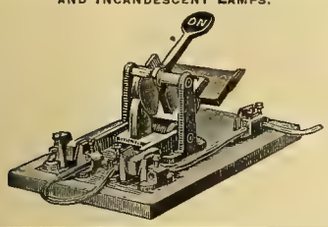

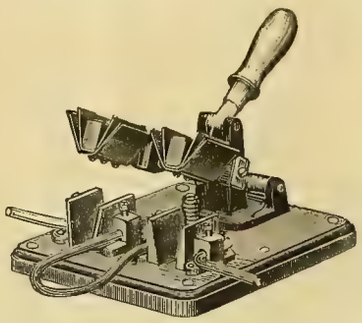

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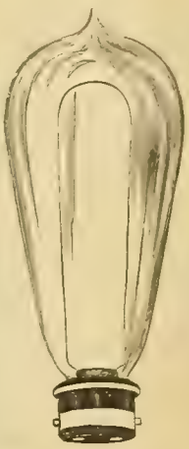
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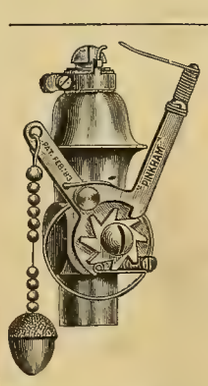

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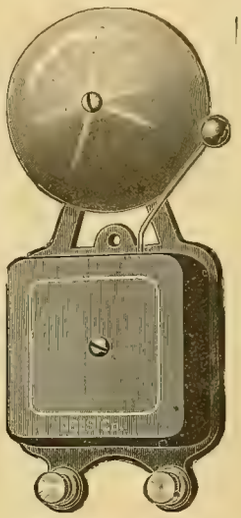

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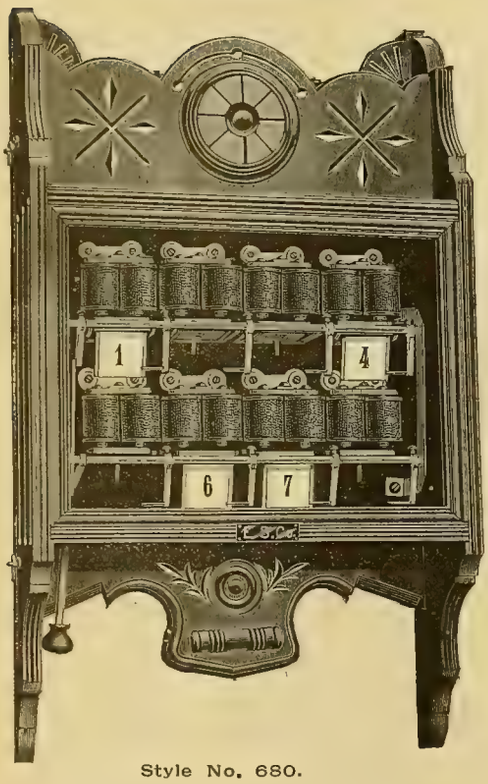

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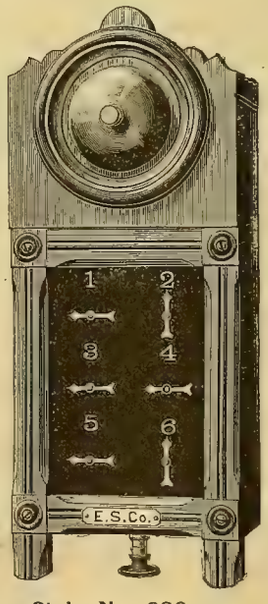

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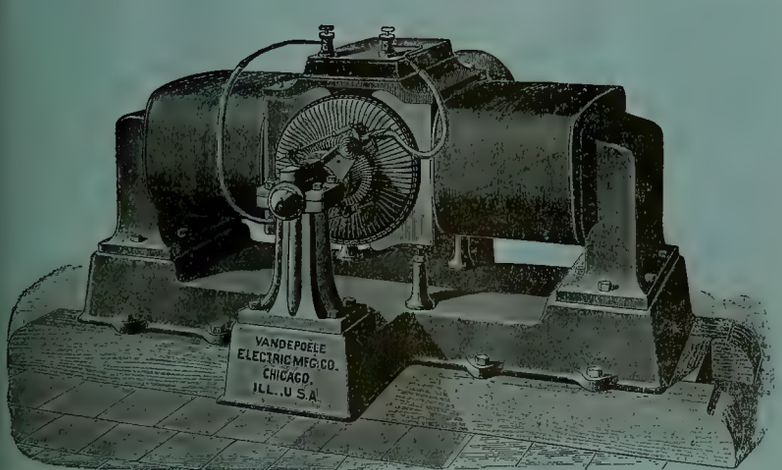

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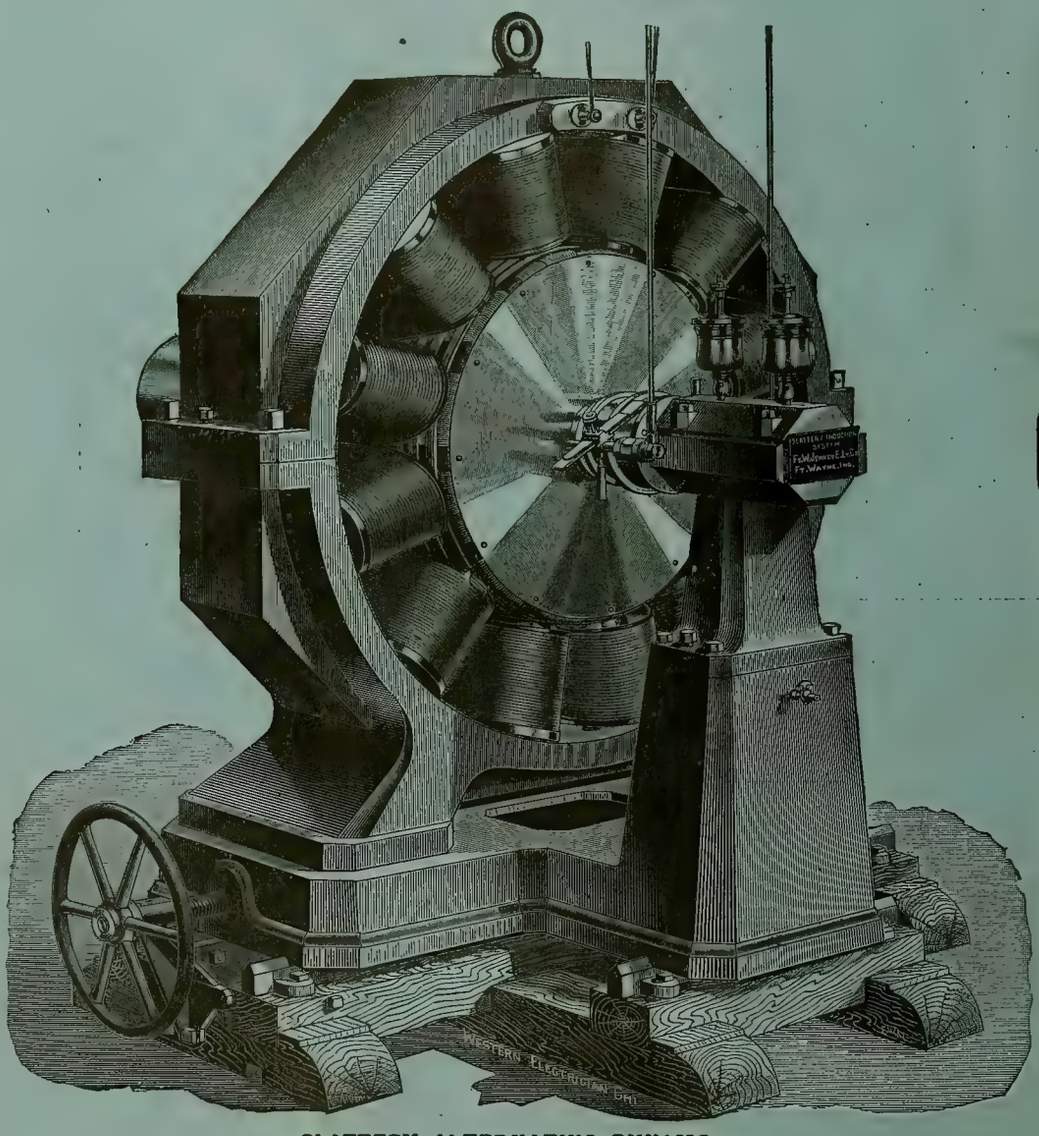

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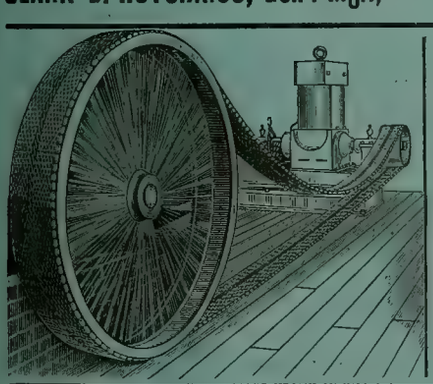

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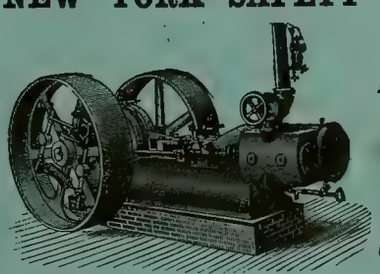

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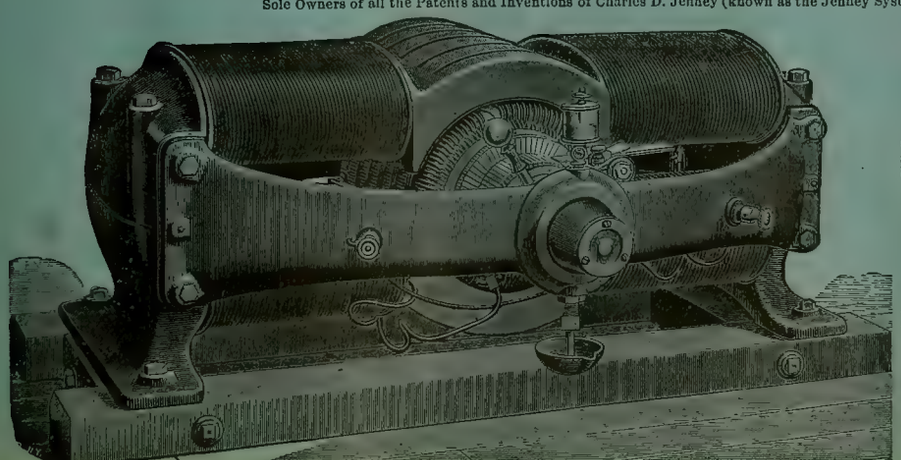

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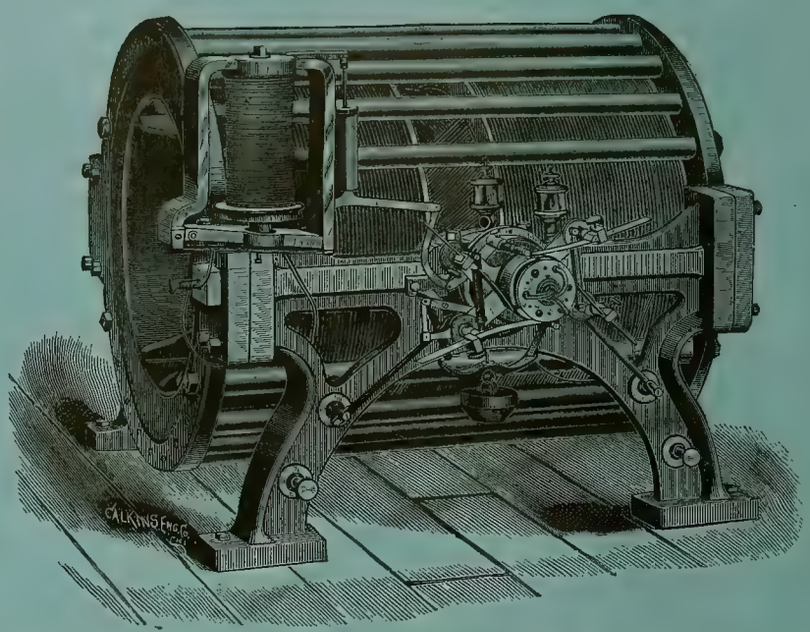

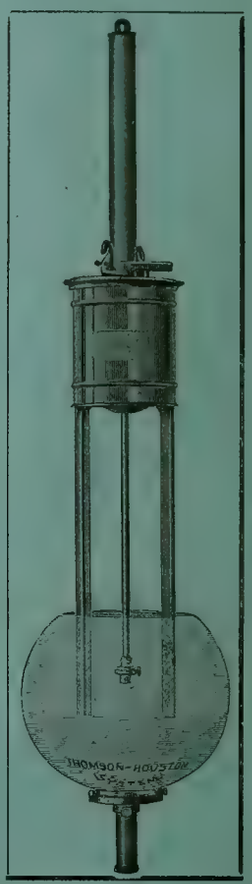

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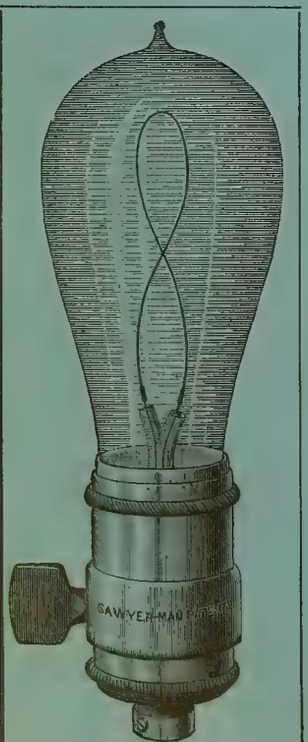

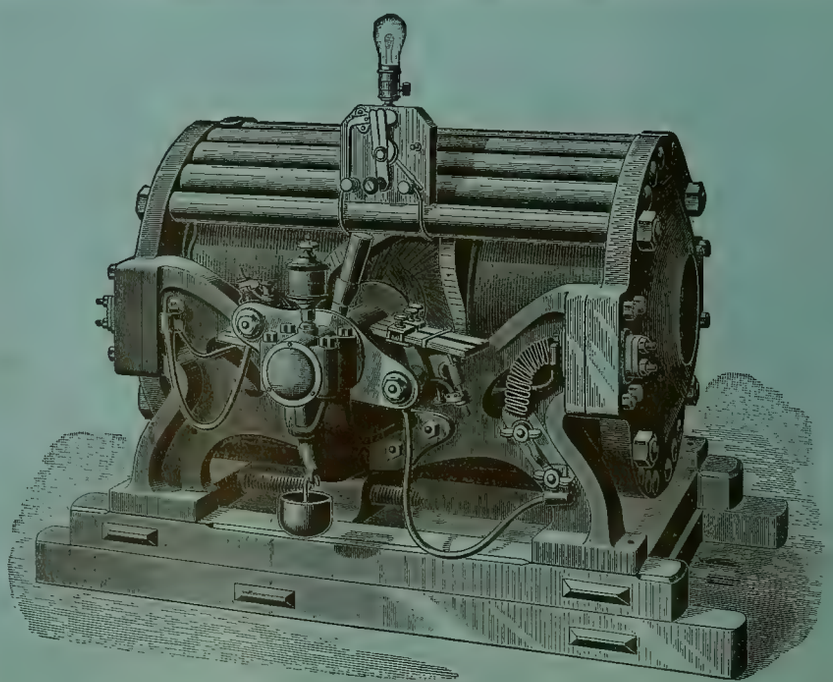

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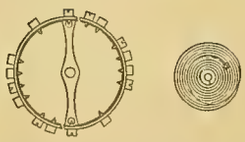

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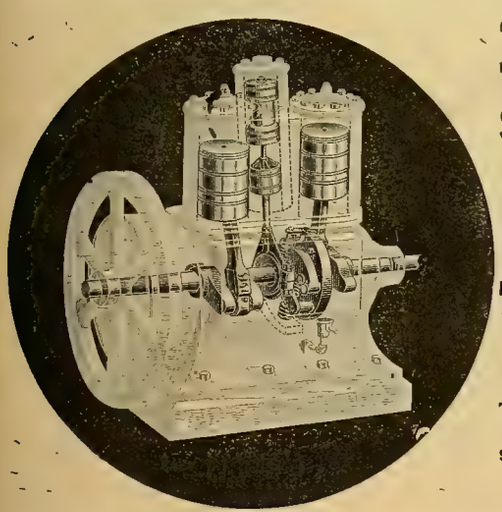

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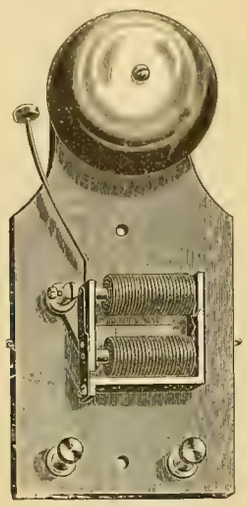

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Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, JUNE 16, 1888. No. 24.

Making Insulated Wires for Electrical Uses.[1]

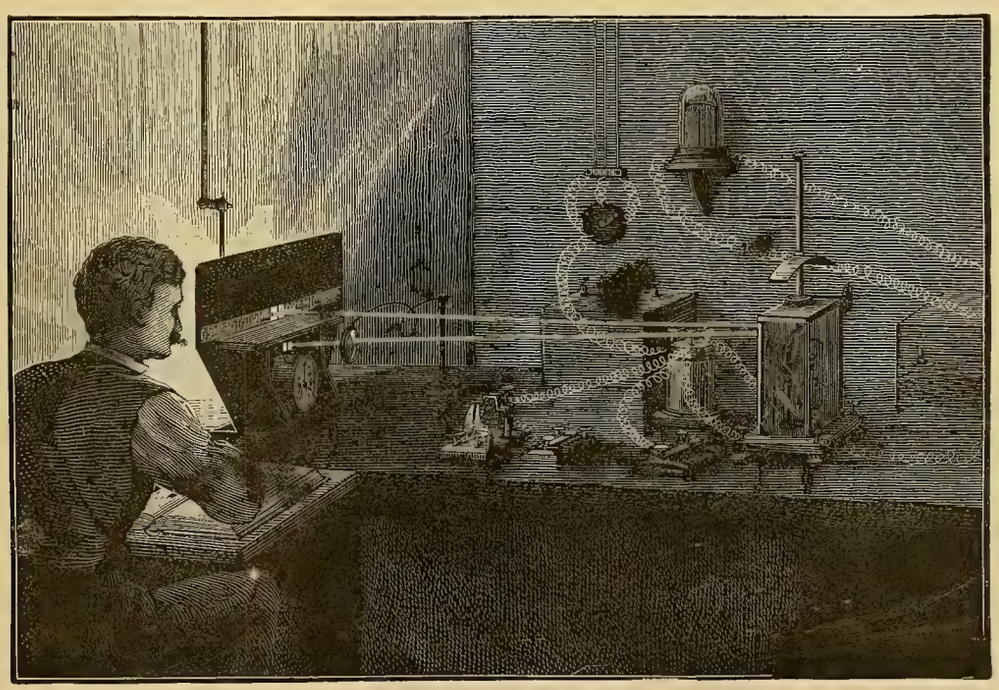
The number of extensive industries which have been developed within a very recent period, growing out of the improvements which have brought electricity into such common use, is something remarkable. An industry of this kind is portrayed in the illustrations herewith, representing the factory and different departments of the Okonite company, of New York, for the manufacture of telephone, telegraph, and electric light wires and cables, for aerial, submarine, and underground use.

The firm name is that of the compound used in covering the wires, a composition which is the result of a long series of experiments and tests to obtain something which, with superiority of insulation, would have great durability, toughness and resistance to the decomposing influence of the elements. In its composition and manufacture the processes followed are somewhat similar to those employed in the making of vulcanized rubber products, such as belting, hose, etc., in which, according to the article to be made, the rubber is mixed with different ingredients, in varying proportions, which the manufacturers have proved of value in their long experience, but the knowledge of which they retain as among the secrets of their special trade, being the result of something over thirty years' experience with the compound. In the manufacture of okonite, however, still different ingredients are used, which give it an exceedingly high insulation resistance, equaling, if not surpassing, the best gutta-percha.

As in the manufacture of vulcanized rubber, it is even more important in making okonite that the sulphur used should be free from acid, and from the moisture which acid sulphur always takes up rapidly on exposure to the atmosphere. Great care is taken in this particular, all the sulphur used being carefully tested, and the mixtures to be worked into the rubber being accurately weighed. The working of the raw rubber, from the first step in its cleansing up to and through the mixing machines and the calenders, is a labor requiring great thoroughness in every detail, and the employment of a great deal of powerful machinery, for it must be worked through and through the different machines many times in order to secure the most intimate mixture and exclude all bubbles and prick holes. These operations, however, are only those incident to the usual manufacture of vulcanized rubber; except that the large rolls of rubber-like prepared okonite, rolled to a thinness ordinarily less than that of a sheet of blotting paper as they come from the last calendering machine, must be of the most perfect manufacture. These strips are usually about three feet wide, and are rolled up with a thickness of duck to support the thin sheet of okonite and prevent its surfaces from sticking together, these rolls being then taken to the wire-covering room, shown in one of the views.

As the okonite is put on the wire before vulcanizing, being then vulcanized in position, a perfect evenness of covering being necessary, an ingenious method of manipulation has been devised for this end. On one of the long tables in the covering room are smoothed out long strips of thinly rolled pure tin, some fourteen inches wide, which are brushed over with a sort of thin varnish, to insure perfect freedom from any dust or dirt, and to prevent the okonite from sticking to the tin. Over these strips the okonite is rolled out to entirely cover the tin, to the size of which it is trimmed, and make a long, smooth band of thin okonite, with a thin tin backing. These bands are then drawn through a cutting machine, by which they are cut into narrow, tape-like strips, and automatically wound upon a reel with many divisons, each tape-like section into its especial division. Thus prepared, the tape-like sections being afterward joined at their ends as the whole are placed on a single reel, the okonite is ready for use in covering the wire. The reel carrying the tin-backed narrow strip of okonite—its width and the thickness of okonite being dependent on the size of wire to be covered and its intended use—is then mounted to feed out in connection with another reel or drum carrying the wire, these reels being located at some distance from the covering machines, so that the wire and covering may be allowed to feed without appreciable tension. At the covering machine they come together and pass through dies, the wire being thereby so thoroughly wrapped around by the okonite and its tin backing as to make the covered wire look like a wire of tin of several sizes larger, so perfect is the covering. The necessity of doing this work thoroughly is obvious when it is remembered that the now covered wire has yet to go into the vulcanizing oven, where it is subjected to a temperature of 275° F. for an hour, the heating being effected by turning the steam directly into the vulcanizers. Any flaw in the tin covering of the okonite would thus be likely to cause pricks or other defects in the okonite. In one of the views may be seen a representation of these vulcanizing chambers, of which there are several of various sizes in the factory; and the large drums in the foreground, on which the wire is wound as it comes from the covering machine, these drums being mounted on low carriages so that they can be conveniently moved about the floor, or rolled from their carriages into the vulcanizing chamber.

After vulcanization, the tin covering or wrapper has to be removed from the okonite covered wire, and this is effected by passing it through a stripper, the operation, as well as that of covering, being effected with a rapidity which hardly seems possible until one has seen it actually accomplished, each conductor, whether it be for a single line wire or one of even hundreds of conductors in a large cable, being thus thoroughly and evenly covered with a strong and durable insulating covering. The company afford any size of wire or insulation, although they use a



Testing Okonite Insulated Wire.

1 *Scientific American.*

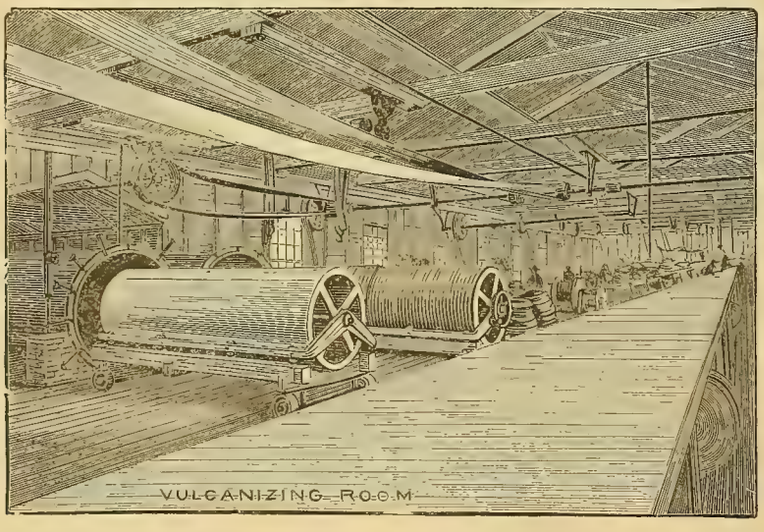
standard of regular thicknesses of insulation for the usual sizes of wire; as, for instance, number 18 wire, according to the Birmingham wire gauge, is furnished with six different thicknesses of insulation, varying from 4-32 to 9-32 of an inch, thus giving a wide variety of goods for customers to select from in all the regular grades.

The wire, having been provided with its insulating covering and tested, is ready to go either to the braiding room, the fireproofing room, or the cabling department. The company make silk or cotton braided lamp cord, and all similar goods, with double conductor twisted or braided parallel, and flexible cords and cables with any number or size conductors for elevator and analogous uses.

The company makes also a less expensive aerial wire, known as the Candee aerial wire, which has given such universal satisfaction that it has required the placing of a great number of new braiding machines within the last three months. The wire after having been braided is then taken to the treating room, where, after treatment in their special compound, it is returned for an additional braid and again treated, thus insuring a thorough saturation of the braid; after this is completed it is sent to the polishing room, when it is ready for shipment.

In the cabling room shown in one of the views are small machines for putting several conductors together in one wrapper, and larger machines for uniting these several strands as it were in a large cable. The strands are fed from spools or reels through apertures in a revolving disk or plate, the reels having a double motion, so that the wires will not be twisted as the cable is formed, the conductors being covered with an extra insulating wrapper and then strongly bound together as the operation proceeds with an insulating material composed of two or four layers of strong tape, with okonite composition between the same, to protect it from injury during handling and use, and an additional protection from dampness or water.

When the cables are to be armored, as is the case in the work for electric light, submarine use, and submarine telegraph cables, where many conductors are cabled together, they are covered with a packing of jute cord to protect the armoring wires from injuring the conductors before being sent to the armoring room. The large machine here used is adapted to put around a cable any number of strands of galvanized wire which may be required, the number actually



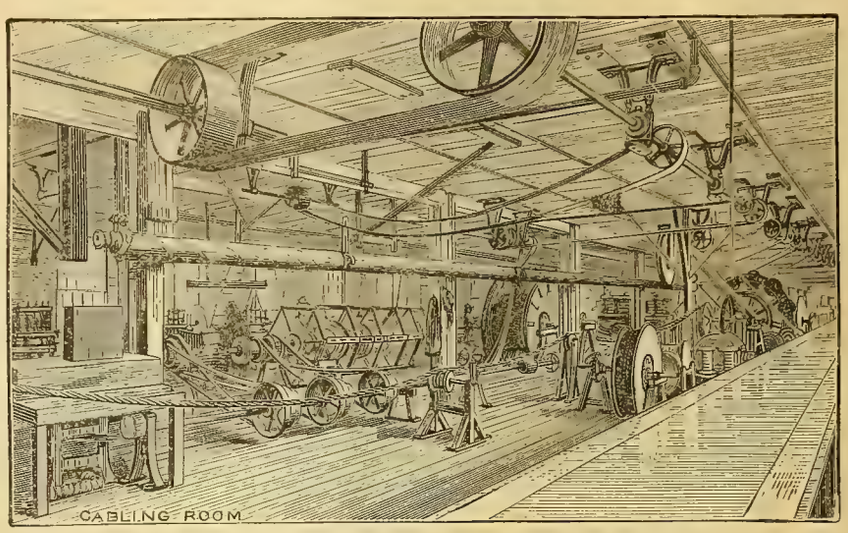
used ordinarily varying from fourteen to twenty-five. The wire is held on spools, revolved by gear wheels; as the machine revolves, the cable passing up through a die plate in the center, through which also passes the armoring wire, being firmly twisted around the cable by the rotation of the machine, while the revolution of the wire-holding spools prevents the twisting of the wire itself. As the cable is armored, it passes over suitable pulleys and is wound directly on large drums, in convenient form for shipping, these drums with their load of cable sometimes representing a weight of several tons each.

Perhaps the most important consideration of all, however, to a customer purchasing such insulated wire, is the question as to the absolute perfection of the insulation. Of this fact, which might be very readily doubted by one who had only gone thus far through the process of its manufacture, it is only necessary to inspect for a few moments the work of the testing room, where all the wires and cables are tested, to be abundantly satisfied. In this room are two Thompson reflecting galvanometers with an expert operator, there being just outside the room large tanks of water, convenient to a table to which the coils of wire to be tested are brought, and placed in water and allowed to remain three days. The operator sees the workman connect the coil with the instrument, and then determines the resistance of the wire. If there be any defective spot in the insulation, the current is short circuited by the water and the defect at once noted by the instrument, its exact location being found on slowly withdrawing the coil.

For making connections and splices, the company manufacture a special okonite tape, which is a thin tape of okonite with a slight cloth backing. The latter is only employed to separate the layers, and must be removed before using, when, the joint being cleaned, the okonite is pressed well over it, and a little heat, as from a lighted match, applied, thus making a joint which is thoroughly waterproof and a perfect insulating medium.

The tenacity and toughness of okonite, rendering it non-liable to destruction by reason of abrasion or rubbing, and the fact that it is not susceptible to extreme changes of temperature, have made this insulator highly popular among all users of electrical supplies, and the company have the highest indorsements as to its value from many of the largest users of insulated wire here and abroad. Okonite wire has been subjected alternately to a temperature of 20° below and 350° above zero, the tests being repeated a number of times, the result showing no apparent change in the quality of the wire.

Charles A. Cheever is the president and Willard L. Candee treasurer of the Okonite company, whose general office and storeroom is at 13 Park Row, New York, N. Y., the factory illustrated being at Passaic, N. J., while their Chicago branch is located at 167 and 169 Lake street.



Electric Light and Telegraphic Facilities for the Republican Convention.

During the last week the busiest place in Chicago has been the Auditorium building. There workmen are completing the arrangements which will make the hall a magnificent assembly room for the National Republican Convention. In every part of the immense hall decorators are hard at work, and it is believed that their efforts will make the building the most brilliant auditorium in which a national convention has been held.

It is estimated that the seats in the building will accommodate 10,000 persons, and there will still be standing room for 1,400 in addition.

The most unique effects will be obtained by the electric lights, which will illuminate the immense hall brilliantly. The building was ready for the electric light men only four weeks ago, and since that time they have been busy almost day and night. The contract was taken by Leonard & Izard, western agents for the Edison company. The distribution of lights was planned by Messrs. Adler and Sullivan, and the construction work was under the direction of G. Hand.

The number of lights will probably be about 3,000, and the general distribution will be as follows:

LOCATION.	NUMBER OF LIGHTS
Gallery over stage	80
Under gallery on stage	80
Two tunnels to the stage	10
Two higher tunnels to the stage	8
Committee room	50
Telegraph room	50
Inclined ceiling over stage	50
Inclined ceiling, arches	300
Stars, ceiling and sides	462
" " "	260
Loops on side walls	94
Balcony rail, 29 3-light bunches	87
Lower balcony rail, 21 3-light bunches	63
Under balcony, adjoining the parquet	80
First foyer ceiling panel, 12 4-light bunches	48
Two side tunnels	20
Two center tunnels	6
Stairways, north and south	16
Center stairway	12
Wabash avenue entrance	75
Congress street entrance	30
Second foyer over seats	48
Second foyer, back of seats	30
Under the lower part of balcony	40
Upper part of balcony	30
Stairway from third to fourth floor	30
Under the lower gallery	104
Under the lower gallery rail	60
Upper gallery ceiling	90
Corridor back of the gallery	90
Stairway from fifth to sixth floor	20
Alley and court	50
Twelve tunnels to balcony	12
Engine room	18
Small rooms	20

In addition to this list there will be many extra lights arranged in different parts of the hall

The building has been wired throughout with kerite and the entire work is now substantially completed. The preliminary tests show that the work has been thoroughly performed in every particular. The main decoration and the most brilliant in effect is an immense shield, 10 by 8 feet, made by the grouping of five hundred 16-candle power incandescent lamps. The globes are red, white and blue. The shield is placed directly above the chairman's desk on the stage. The ceiling in the main part of the hall will be lighted by twenty-two large stars, each of which is made by twenty-one 16 candle power incandescent lamps.

On the side walls north and south are arranged twenty-six smaller stars, each composed of ten 32-candle power lamps. These stars are placed over flags and about the national coat-of-arms.

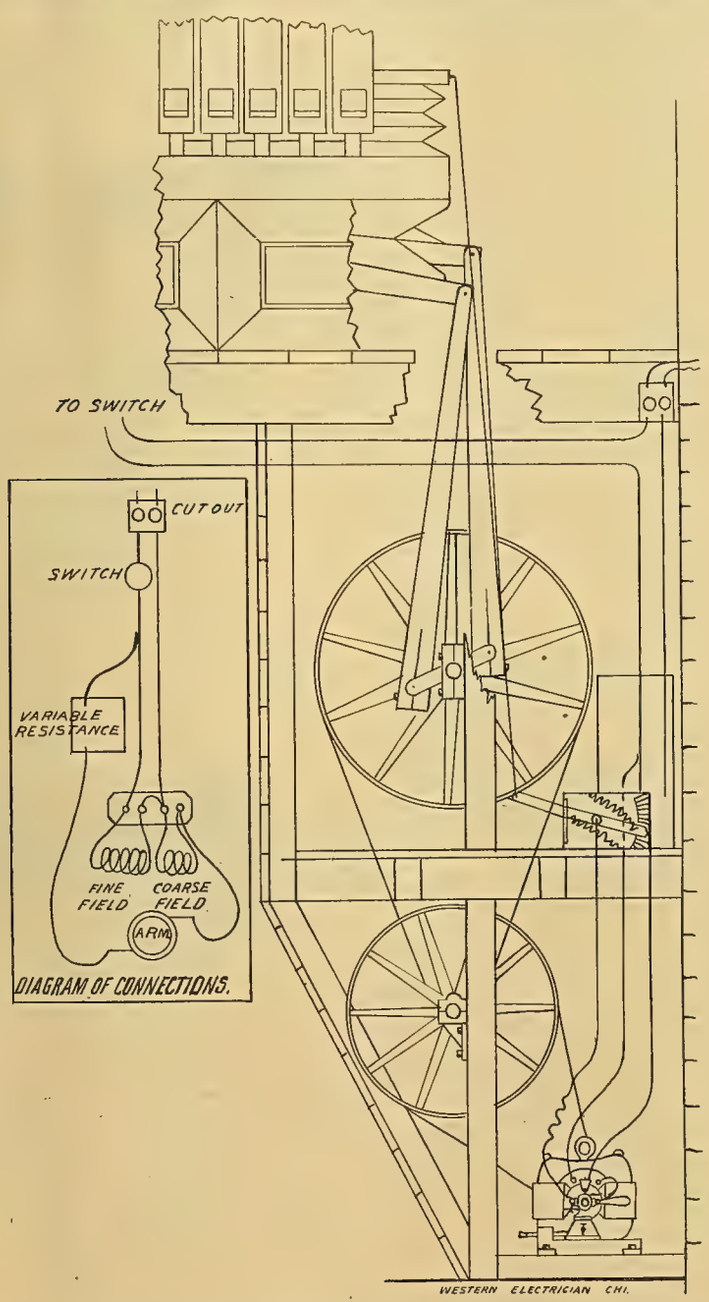
On the balcony rail there are sixty three-light groups. The decorations of flags and bunting are of the most elaborate character, and when the current is turned on the effect is wonderfully brilliant.

The dynamo room is near the Michigan avenue side of the building. The plant consists of two Edison number 32 dynamos; two Ide engines each of 125 horse power are employed.

The telegraph facilities will be ample. The companies have been afforded all the space they require for their operators. The Western Union and Associated Press will be located in the north side of the building adjoining the stage. The Western Union will run about thirty wires into the hall, so that all the principal cities in the country can be reached. The company's force will consist of about twenty-five operators. The Postal Telegraph company's quarters are on the opposite side of the hall; about twenty-five operators will handle the business. Twenty-five wires will be run to their room. Both companies will have a force of messengers in attendance, so that they can send to the main office any dispatches to cities not reached by the wires entering the convention building. When the companies and press associations are ready for work about 100,000 words can be sent over the wires hourly.

Automatic Regulation of an Organ-Blowing Motor.

On this page is shown an illustration of the connections to a one-horse power Sprague special pumping motor used in the Plymouth Congregational church in Des Moines, Ia., to furnish power to operate the bellows of the organ.



Originally the resistance was connected in the main line and the motor cut entirely out of circuit where the bellows filled; but the frequent starting of the motor made the lights in the church flicker as well as caused unavoidable sparking at the brushes.

To do away with these objectionable features L. G. Wilson, electrician of the Des Moines Edison Light company, designed the automatic regulating device shown in the outline cut, in which the resistance is placed in series with the armature and coarse coils of the field magnets. The resistance box contains about 30 ohms separated into eight sections, which are gradually thrown into circuit as the bellows fill. With the resistance all in the armature of the motor revolves only fast enough to supply leakage of air in the bellows.

The motor is started and stopped by the organist with an ordinary switch placed over the key-board. This is the twelfth motor installed in Des Moines this year by H. D. Woodruff, the local agent, and it is thought is the first electric motor in the United States employed to pump a church organ.

Bell-Cushman Litigation.

For five days last week in Chicago Judge Blodgett heard arguments in the Bell-Cushman litigation. The arguments were made with spirit and with a full realization of the importance of the suit to each party. Both defendants and plaintiffs were confident that the decision of the court would be in their favor.

At the conclusion of the two days' speech of George L. Roberts, who represented the Bell company, Judge C. D. F. Smith made the opening argument for the defendants. He reviewed the testimony taken by the defense, dwelling especially upon that portion which related to the alleged discovery in 1851 by Dr. Cushman and the early use of the instruments by the defendant and his friends. He described in detail the way in which the "talking boxes" had been used, and spoke of the improvements in them which had been made by the defendant and his friends and relatives. He thought the use of the telephone had been proved by an overwhelming mass of unimpeachable testimony. He did not claim that the machines were perfected; far from it, but he did assert with confidence that the principle of the magneto telephone was involved and he thought the evidence warranted the assertion. He thought, too, that they could be employed for commercial purposes, and he cited the evidence of Prof. Cross, an expert in the employ of the Bell company, who had tested boxes similar to those which the defendant had made. Judge Smith spoke at length of the contract with the Bell company, which Dr. Cushman signed. The object of this agreement was to keep quiet the defendant's claim to priority. The latter was to turn over his memoranda pertaining to his inventions and not to communicate with reference to them. While he was thus in the employ of the company nominally as an electrician, he was never called to do a stroke of work. The inference was that he had substantial claims to priority of invention.

Did the Cushman devices antedate the Bell patent of 1876? In answer to this question counsel cited the testimony of experts, including that of Prof. Charles R. Cross, to show that the Cushman "talking boxes" solved the problem of the transmission of sound to the same extent as the original Bell telephone. If Cushman had the device, however imperfect, for the transmission of sound, then he anticipated Bell. Counsel would go farther and claim that if Cushman even had a device which under development would be capable of such a use, he anticipated Bell.

The courts have held that when Bell received a patent in February, 1876, he simply had a conception of a way by which articulate sounds could possibly be transmitted. Cushman's devices were proved to have been in actual use in the years 1851-1855. The Bell devices exhibited at the Philadelphia centennial in 1876, counsel claimed, were no better than the old "lightning arresters" produced by Cushman in 1851.

The recent decision of the United States Supreme court in the telephone cases was quoted from, to show that the Bell patent of 1876 was merely on a conception of the true method of transmitting articulate sounds. This decision proves that it is not necessary for a person to have perfected an invention before securing a patent. According to this theory, Dr. Cushman was entitled to a patent more than twenty years before Bell applied for one.

In conclusion, Judge Smith said it is immaterial in the present case of what use the telephone has become in the commercial world. It is not material that on the one side is ranged a corporation backed by millions of money and on the other side a poor corporation. It is not material that one represents a powerful monopoly, and the other is struggling for the rights of the

people. The parties to the suit are before the court in the same position that they would have been before the commissioner of patents in February, 1876. If both parties to the suit were thus viewed, it would be found that on one side is Prof. Bell's claim for a conception merely, and on the Cushman side the claim is made of work actually performed. The fact that Cushman slept on his rights so many years is his misfortune. If the Cushman company succeeds in the present contest the effect will not be to enrich Dr. Cushman or the company but simply to throw the manufacture and use of telephones open to the world.

Benjamin F. Thurston followed in an argument for the Bell company. He contrasted the conduct and statements of Dr. Cushman between the years 1876 and 1885 with his conduct since the Cushman telephone company was formed, and claimed that they were utterly irreconcilable with each other. He endeavored to impeach the truthfulness of Cushman's claims as to the specific circumstances under which his experiments were made about 1855. He spoke of the fact that while some of Cushman's inventions were accepted by investors, his talking box was rejected as useless. He averred that the Cushman device was simply the acoustic telephone which had existed for a century.

The case for the Cushman company was closed by James L. High. He said the conclusion was irresistible that Dr. Cushman had invented a magneto telephone in 1851, unless there was a gigantic conspiracy involving twenty-two witnesses, clients and counsel. There was but one question in the case: Whether their use was practical and successful or an abandoned experiment. The Racine test at the "rope-walk" was sufficient to answer this question, and the defense could safely rest its case on that. The original Cushman telephone was as satisfactory as the Bell telephone without the Blake transmitter. If they were merely acoustic telephones, why did the Bell company make a contract with Cushman after months of investigation? The difference between magneto and acoustic telephones was explained, and counsel challenged the Bell company to prove that acoustic telephones were in existence at the time mentioned. The defense had produced ten witnesses who swore that they saw magnets inside the original Cushman telephone. The witnesses also say that there was a ground wire used in connection with the Cushman telephone, which experts testify is not used in connection with acoustic telephones.

Mr. High said: "Dr. Cushman did not patent his invention because at the time he did not believe it worth patenting. In 1851 the country was not ready for the telephone. The telegraph was then in its infancy and had not been successful in the West." He summed up the law bearing on the case, and quoted a large number of authorities, including the minority report in the recent telephone decision of the United States Supreme court.

The closing argument was made by Chauncey Smith, of Boston, of counsel for the Bell company. Mr. Smith said that prior to 1876 the telephone was not known, and when Prof. Bell published in that year an account of his experiments, it was impossible for the telephone to have relapsed into obscurity. This is what Cushman claims happened to his telephone after he had made more important uses of it than had Bell. Whatever use Cushman may have made of his talking-boxes, the fact is undeniable that the experiments were abandoned, and the original instrument lost.

In the Drawbaugh case 150 witnesses testified to a telephone antedating Bell's patent, but the court decided that the claimant's general conduct was such that the Bell patents could not be interfered with. In the controversy between Bell and Cushman the court is asked to believe what Cushman himself did not believe, viz.: that his invention had a practical use prior to 1876. If his story is true, it is incredible that some one was not found to make practical use of his "talking-boxes." When Cushman saw telephones going into actual use, after Bell secured his patent, he did not, even then, go to the patent office for protection. Counsel said the courts have decided that such conduct is inconsistent with human nature if there are real claims in existence.

Dynamo Tenders' Hand-Book.[1]

By F. B. Badt.

PART V.

CIRCUITS OR LEADS.

Chapter XLI.

Outdoor Leads for Arc Lighting.

The wire used for outdoor circuits is mostly what is called underwriters' standard. It consists of a copper wire which is braided with cotton and painted with asbestos to make it uninflammable. This wire is fastened to glass insulators on poles or houses in a way similar to that in which telegraph wires are usually run. Insulated wire, and not bare wire, should be used for tie wire, as the common non-insulated tie wire will cut the insulation of the line wire and possibly cause leaks. The size of arc light conductors varies between numbers 6 and 4, Brown & Sharpe gauge, number 6 being the smallest wire which can be used, according to the rules of the National Board of Fire Underwriters. If the return wire is fastened on the same poles, the positive and negative wires should be kept sufficiently far apart so they can not touch each other when swung by wind. It must be understood that the insulation called underwriters' standard is only an insulation when perfectly dry, and when wet is hardly any insulation at all. If, therefore, the positive and negative wires exposed to rain or moisture of any kind should come in contact with each other or with the ground, a short circuit would be caused. This may cut a number of lamps suddenly out and cause damage to the dynamo. Such an accident, for instance, may burn out the armature or throw off the belt. In very cold weather such occurrences are rare, as frost may make out of a circuit of the poorest insulation one of very high insulation, while on the other hand a thaw or rain may cause all kinds of disturbances. If these disturbances occur during a thunder storm accompanied by rain, lightning is often unjustly accused of having done the mischief, while in fact the poor insulation of the wires is the prime cause.

Accidents from poor insulation of lines are more frequent than damages caused by lightning, though the latter will always be a ready excuse for anything that may have happened. Recently weather and water-proof insulation have come in vogue, and they are much safer than underwriters' standard wire.

In conducting wires into houses, great care must be taken to prevent rain following the wires. The wire should be fastened to the insulator below the point where it is intended to be led through the wall or a window frame, so the rain would have to run up hill in order to follow the wire, Fig. 35.

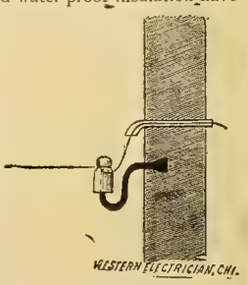


Fig. 35. — Proper Position of Insulator.

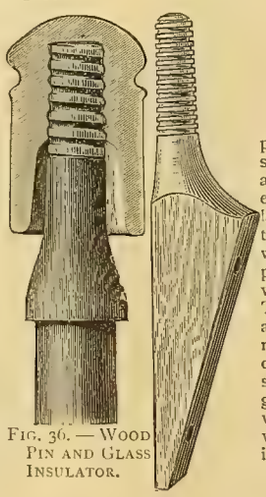


Fig. 36. — Wood Pin and Glass Insulator.

Fig. 36 shows a wood pin and glass insulator, such as are used on cross arms. The latter are fastened to poles by means o lag screws. Fig. 37 illusf trates a wood bracket, which can be spiked to poles or houses and provided with a glass insulator. The glass insulators must always be fastened in a nearly vertical position, the closed end on top, so the space between the pin and glass insulator, Fig. 36, will remain dry in rainy weather and secure perfect insulation.

Fig. 37.—Wood Bracket.

Fig. 38 shows a rubber hook insulator. This should for the same reason be fastened with the hook downward. A hole can be bored with a 5/8 inch bit underneath a cross-arm and the rubber hook screwed in with a wrench.

An extra heavy insulating material, such as rubber hose or hard rubber or porcelain tube, Fig. 39, must be put over the wires where they pass through walls or partitions.

Poles for lines should be set deep enough in the ground; the depth, of course, will depend upon the soil and the height of the pole. In sand, at least one-fifth of the length of the pole should be buried in the ground, while in rock one-tenth of the length is sufficient. In putting up wires, the season, or, in other words, the temperature, should be taken into consideration, allowing for contraction in cold weather. If, for instance, a wire should be put up very tight in July, it would cause a good deal of damage in breaking off glass insulators and pins as soon as the temperature fell to zero and caused the wire to contract. Corner poles must be braced or anchored to keep them in a nearly vertical position. See Figs. 40 and 41.

Fig. 38. — Rubber Hook Insulator.

When a splice is necessary, it should be made after the fashion of the American telegraph splice, Fig. 42, and should be perfectly clean and solidly soldered and then

Fig. 39. — Hard Rubber Tube.

well taped with insulating tape. In order to prevent the tape from peeling off, it is advisable to fasten the last turns of the tape to the wire with a few turns of bare copper

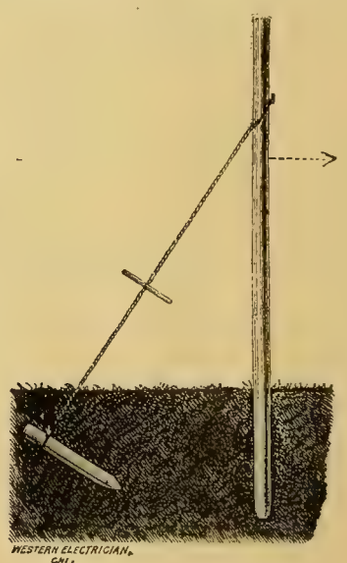


Fig. 40. — Corner Pole Anchored.

wire, say about number 20. If this precaution is omitted the tape is sure to peel off in time. Most of our electric light lines will show places where the tape is hanging down a couple of feet. Besides, having no insulation on

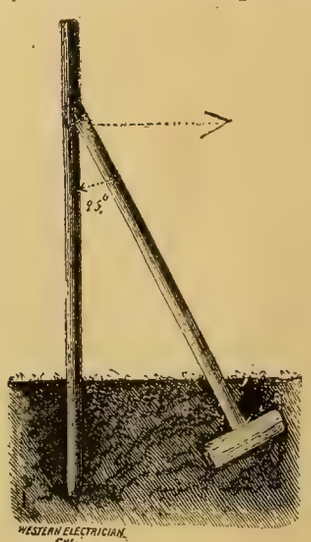


Fig. 41. — Corner Pole Braced.

the splice, this, of course, does not contribute to the beauty of overhead wires.

Brass line connectors, Fig. 43, are only allowed for

1 Dynamo-Tenders' Hand-Book, by F. B. Badt; 100 pages, 70 illustrations; flexible cloth binding; type page 6 x 3 inches; published by Western Electrician Co., price $1.

inside work where there is no strain on the wires, The set screws should be well tightened, and the connector be run full of solder and taped. Good soldering and taping

FIG. 42. — AMERICAN TELEGRAPH SPLICE.

of joints will save at least 50 per cent. of all the troubles that occur in an electric light plant. Joints should never be left unsoldered, even if persons who claim to know all about it should think it unnecessary. The best apparatus for soldering joints on line wire out of doors is the gasoline blow-pipe, Fig. 44. Every trace of acid should be wiped

FIG. 43. — BRASS LINE CONNECTOR.

off the wire with a moist or oily cloth before taping, to avoid corrosion.

CHAPTER XLII.

Outdoor Leads for Incandescent Lighting.

The rules which were given for outdoor arc light lines can be applied for incandescent light lines. As the wire used will very often be considerably larger than number 4 wire, the poles, cross-arms and other supports must necessarily be heavier to stand the greater strain, and poles should be set closer together. In a low tension incandescent system, very often bare wires are used, and still more

FIG. 44. — GASOLINE BLOW-PIPE.

care must be taken to prevent accidental contact of the positive and negative wires with each other or with the earth.

CHAPTER XLIII.

Arc Circuits Inside of Houses.

The wires for these circuits should be fastened to porcelain insulators, Fig. 45, and be exposed to view. Owing to the high tension which prevails in arc light circuits, the concealing of these wires is not permitted by the underwriters. The directions given for splicing and insulating hold good also for inside wiring.

In rooms which are exposed to steam or moisture, as, for instance, in packing houses, wire with a better insulation than underwriters' standard must be used. The moisture which covers insulators and wire would cause considerable leakage, and, besides, would corrode the wire. The use of wood cleats or iron staples instead of porcelain

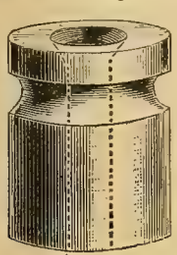


FIG. 45. — PORCELAIN INSULATOR.

insulators should not be permitted in any case, as they are liable to cause grounds and, in fact, have been the source of mischief in a good many cases in years gone by.

CHAPTER XLIV.

Incandescent Circuits Inside of Houses.

In the low tension systems, wooden cleats or wooden molding are permitted for fastening the wires to the walls and ceilings if there is absolute safety from moisture. Underwriters' wire may be used also under the same conditions. If there is any possibility of moisture getting to the wires, the latter should be first-class waterproof insulation. If any "fishing" has to be done, where wires are to be concealed under floors, above ceilings, or between walls or laths, only waterproof wire can be used. Incandescent wiring inside of houses requires a good deal of skill and experience, and should only be intrusted to reliable and responsible concerns. Unfortunately, any man who ever fastened a piece of wire for a bell-pull, thinks himself an expert also for incandescent wiring; a good many even important jobs have been done by such men, with the result that, after a great expenditure of money by the owner of the house, the whole system had to be condemned, as not an inch of the wire had been put in properly and could be used.

The joints or connections in waterproof wire should be made waterproof also. This is done in the following way: After having spliced, soldered and cleaned the wires properly, cover the joint with hot Chatterton's compound by

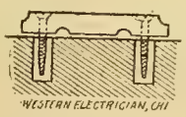


FIG. 46. — WOOD CLEAT.

molding it between the fingers to almost the total thickness of the insulated wire. Then cover it with kerite tape and give it a second thin coating with hot compound, or hot asphaltum, and then give it a second coat of kerite tape. Hot liquid asphaltum should be used in lieu of compound where there is danger from sewer or illuminating gas that

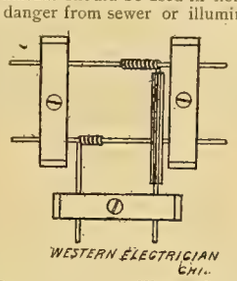


FIG. 47. — PROTECTION OF WIRES CROSSING EACH OTHER.

is prevalent in the soil and basements of houses in large cities.

Figs. 46, 47, 48, 49 and 50 show the use of cleats. Fig. 46 shows a familiar form of cleat. Where the positive wire crosses the negative, an extra protection of rubber tube is required to prevent any danger from short circuits, Fig. 47.

In passing through a wall, each wire should be inserted in a separate hole, lined with a hard rubber tube, Fig. 48,

FIG. 48. — WIRES IN SEPARATE HOLES.

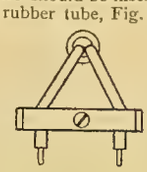


FIG. 49. — WIRES IN SAME HOLE.

or each wire should be covered with soft rubber tubing and both may be drawn through one hole, Fig. 49, lined with a pipe of non-conducting waterproof material.

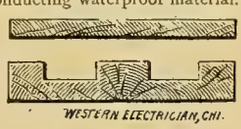


FIG. 50. — WOOD MOLDING.

Fig. 50 is a cross-section of wood molding. The lower part is fastened to the wall or ceiling, the wires put in—positives in one groove and negatives in the other—and the cover screwed on. Care must be taken that nails or screws do not touch the wires.

The safety plugs are put in the circuit according to the rules of the fire underwriters. They must be of such size that they will fuse before the wire they have to protect can get dangerously warm.

CHAPTER XLVI.

Testing.

The circuit should be tested every day for grounds by means of the detector galvanometer or a magneto bell. If a ground is indicated it should be speedily located by dis-

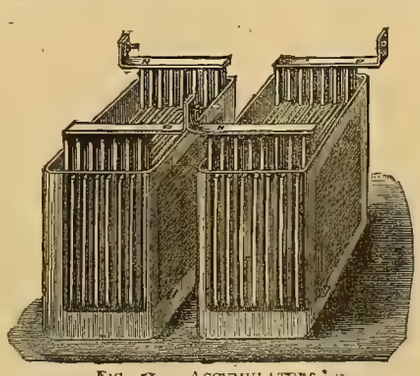


FIG. 51. — ACCUMULATORS.

connecting the circuit in different places and taking each section separately, until the ground is located. [See also Chapter XXXIX.]

ACCUMULATORS.

CHAPTER XLVII.

Accumulators, Fig. 51, or secondary batteries, are used for the storage of electricity. They consist generally of glass vessels containing a solution of sulphuric acid and water in which lead plates, insulated from each other, are placed. The positive and negative lead plates are called the electrodes. These batteries are usually charged with shunt dynamos. A chemical change in the plates is produced. In discharging, the plates try to return to their first chemical condition and in doing so they generate a current.

The e. m. f. of an accumulator is about 2 volts. In order to burn 100 volt lamps, 50 accumulators must be connected in series. The maximum current strength they should be allowed to yield is generally given by the manufacturer. It is in the neighborhood of 35 amperes, which can be yielded for ten hours, or, as it is expressed the accumulators can yield $35 \times 10 = 350$ ampere hours. Hence a battery of 50 accumulators could yield 350 ampere hours at 100 volts pressure. If we had 100 volt 16 candle power lamps requiring ½ ampere each, we could, for instance, burn 70 of these lamps 10 hours, or 35 lamps 20 hours, etc.

(*Concluded.*)

American Institute of Electrical Engineers.

FRANCIS B. CROCKER'S PAPER.

MR. CROCKER: In regard to batteries, I do not wish to be understood as entirely skeptical in the matter. As I have said, the possibilities are almost infinite, but there are certain facts which can not be overcome, which might as well be looked at straight in the face in the beginning as after the company is formed and the failure occurs. [Laughter.] There are certain legitimate applications of primary batteries even in their present state of imperfection. For example, a primary battery, a Leclanché cell, is very satisfactory for ringing electric bells — we do not need a dynamo for that purpose — and for telephone work, and even for small power uses, although I have not yet seen the battery which will practically generate electricity for a reasonable price. As a luxury, we can have a battery; or, for some very special work like a dentist's, or a physician's work, where a horse power hour may be worth $1,000. There he could afford to use the silver-chloride battery, and throw away the silver. [Applause].

DR. MOSES: I think that we are very much indebted to Mr. Crocker for the able paper, and we can not too highly laud the time, the energy and self-abnegation devoted to preparing a paper for the institute, of that character. There are some questions he will permit me to ask him that will lead to others, and in that way to a useful debate. I notice, that in this table, D, you have used chlorine, bromine and iodine for the three elements that you combine. Why did you select those whose atomic rates are perhaps less accurately determined and which are not absolutely considered as elemental in their character? Why did you not, perhaps, take a combination of oxygen, or even carbon, for that purpose?

MR. CROCKER: In the first place, as I have said, oxygen, pure and simple, can not be combined directly with zinc. You can not have free oxygen. It will not dissolve in the solution — to a certain extent, it will, and it would be possible to use it, but only in a very delicate way; whereas bromine, chlorine, and iodine will actually be dissolved in the solution and be used in an elementary state. So far as the elementary character of bromine, chlorine, and iodine is concerned, I have never heard it assailed before. If you mean that all so-called elements are not elements, and that hydrogen is really the only element, why, then, of course, they go with the others; but so far as I have ever heard, they stand on the same basis as carbon, oxygen, and so on; and then, furthermore, they constitute a series of chemical elements; they are related to each other, and in that way they are successive elements so to speak. The results obtained are more clear and more instructive when a series of elements are used in that way than when you pick out elements at random; for instance, oxygen and carbon are acids, because they are not on the same basis. The real depolarizers are those elements, the chlorine, for instance, and bromine and iodine. Now, chromic acid itself is not a depolarizer; it is merely the oxygen it contains. In that case you use oxygen, but you do not use it pure and simple; it is in combination with chromic oxide, and, therefore, the oxygen is complicated. It is perfectly possible to apply these to any other chemical combination; but when we have to deduct a certain force by which the oxygen is held with the chromic acid, then it makes a more difficult and less clear problem.

DR. MOSES: The figures are very conscientiously put, and the statement which Mr. Crocker makes that he puts down here a negative quantity simply because his galvanometer shows it is a very acceptable statement, because he shows what he gets. Even the most inaccurate observations of results, if the methods are given, prove of equal value with the most accurate, as we recollect in the case of Vanquelin's analysis in the beginning of this century, though done in the most imperfect way, according to present methods, are very valuable, because he gives an account of how he did it. But there is a series of facts there that I think are of interest that come out from an inspection of the table, and that rather tend to point the moral, which is, that chlorine is itself not an element. I would like to recall to Mr. Crocker's attention the fact that the very discoverer of chlorine doubted its elemental character for a very long time, and it is to-day a mooted question whether it is a simple element. You have in that table a series of comparisons in which you find, with but one exception, that the determination is less than the calculated

1 Discussion of papers published in Nos. 21 and 22 of the WESTERN ELECTRICIAN.

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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Notice to Subscribers.

Subscriptions to the WESTERN ELECTRICIAN, weekly, at $3 per annum and *The Electrical Engineer*, of New York, monthly, at $3 per annum now filled from this office at $5 per annum for both journals.

THE annual meeting of the Chicago Electric club will be held at the club rooms Thursday evening next, June 21st.

REPORTS agree that the prospect is not brilliant for the copper syndicate. The increased price of the metal has been followed naturally by a restricted demand. Prices are lowering and visible supply is increasing.

A VERY well equipped, admirably arranged and scientifically managed station will be the conclusion reached after a reading of our Minneapolis correspondent's description of the Minnesota Brush company's plant in Minneapolis.

Mr. NILSON'S device for the automatic regulation of a motor used for pumping an organ is unique and original. The arrangement was designed to do away with the flickering of the lights in the church when the motor was started.

THE Chicago Gas trust seems to have been too strong for the city council, for at the last meeting by a close vote, important resolutions relating to the trust were placed on file and probably will never be taken from their respective pigeon holes, by the present board at least.

IT is understood that the American Electric Manufacturing company whose financial difficulties were noted several weeks ago will be able to tide over their trouble and resume business again. The American company has many strong friends who will be pleased to see it on its feet.

DISPATCHES indicate that St. Louis is threatened with a telephone war of formidable proportions. It is greatly to be hoped that a compromise can be effected between the municipal authorities and the telephone company. Such controversies injure a city as well as materially reduce the income of the telephone companies.

OUR correspondence this week has trespassed upon columns that we fain would have reserved for other matter, but recognizing the value of bright, fresh, crisp news of what is going on, we have given away and allowed the news columns to expand. Aside from letters from regular correspondents we publish letters from nearly every state west of Ohio to the Pacific slope. We commend the columns to more than usually careful reading.

ON the same evening that the Chicago Electric club will hold its annual meeting, the Boston Electric club will celebrate its first anniversary. The programme includes a reception at the club rooms from 1 to 4:30 p. m., during which addresses will be made, chief among which will be an explanation of the operation and exhibition of the Edison improved phonograph by E. T. Gilliland. At the conclusion of the ceremonies of the afternoon members and guests will leave for Nantasket beach, where dinner will be served.

WILL Chicago be visited by telephone disputes? It is to be hoped that no such vexatious event will occur. It is reported, however, that the corporation counsel has begun the investigation of the right of the city to regulate telephone rates. It has been supposed that this right was vested in the legislature, but since the action of the St. Louis city council the question has been discussed in Chicago. The city fathers are not favorably disposed toward the telephone company and it is not unlikely that they will take action if the city legal department can find the necessary authority to warrant them in considering the matter.

CHICAGO rarely does anything by halves. The city will maintain its reputation in the auditorium which is being fitted up for the Republican national convention. Never has a body of political delegates seen such a display of electric lights as will be seen in the immense hall. The arrangement of lights, too, has been made such that they will form the chief decoration in the auditorium. A splendid ornament is a large banner made by the grouping of incandescent lamps with red, white and blue globes. The trial tests show that everything is in splendid working order, and those who have the work in charge deserve congratulation for the successful accomplishment of a difficult task in a remarkably short time.

JUDGE BLODGETT, of Chicago, listened all last week to arguments of counsel in the Bell-Cushman litigation. He made the remark, it will be remembered, before the case was opened, that he knew absolutely nothing of telephony, practically or theoretically. He will never be able to make a similar statement. Counsel commenced with the theory of sound and then followed with the rudiments of telephony, describing every point with considerable minuteness. The court was also posted in reference to every phase of telephone litigation, so that Judge Blodgett now understands the subject from a theoretical standpoint, although the pleasure of conversing by means of a telephone is still reserved for him.

THE *Progressive Age* says: "A feature in regard to gas that electrical people do not particularly dwell upon is that gas promotes the ventilation of factories and other buildings, where suitable openings are provided. But experiments recently made at the National Theatre at Munich, Germany, in regard to the relative effects of electric light and gas light upon the air are reported to have shown most satisfactory results in favor of the former. What we all do know is that both are a long ways ahead of oil lamps of any sort, or the 'tallow dips' of our grandmother." A fact which electrical people do dwell upon is that "factories and other buildings" lighted by electricity do not need such ventilation as structures lighted by gas, in which the air is constantly vitiated by the burning gas. Go to any place, such as a printing office, where electric light has been substituted for gas and the truth of the statement just made will be sufficiently demonstrated. If additional evidence is desired let the employes be interviewed on the subject.

NOT quite a year ago the world was stirred by the reports of important concessions said to have been granted a syndicate of American capitalists by the Chinese government. The alleged concessions granted rights to establish a bank, and to construct railway, telegraph and telephone lines. The WESTERN ELECTRICIAN published from time to time as much as could be obtained from various sources of the negotiations in progress, including some comments on the history of Count Eugene de Mitkiewicz, who was instrumental in securing the alleged concessions. An interesting sequel is brought out by our New York correspondent, who refers to a suit instituted by Count Mitkiewicz to compel Wharton Barker, the Philadelphia capitalist, to compel a specific performance of agreement. Although Barker claims the concessions were repudiated by the viceroy, it is claimed he represented otherwise to induce a $100,000 subscription. The plaintiff alleges that through Mr. Barker's failing to carry out the agreements he has not been able to fulfill his promises to the Chinese officials, and that distrust has been engendered, which imperils the schemes.

The outcome will be awaited with interest.

NOW THAT the act substituting electric executions for hanging has become a law in New York state, the legislature which passed the act has received a large amount of praise. The overcautious look with a certain amount of uneasiness at the change, but the general feeling seems to be approval.

With one clause of the law not a little fault is found. This provision is made: "No account of the details of any such execution beyond the statement of the fact that such convict was, on the day in question, duly executed according to law at the prison, shall be published in any newspaper." It is unquestionable that considerable interest will be taken in the new mode of execution, and the law prohibits the gratification of this interest. It is predicted that this provision will not be enforced, as it will not be approved by public opinion. In this connection two extracts from newspapers which consider this change from different standpoints are interesting. The Chicago *Tribune* says: "Gov. Hill has approved the bill passed by the New York Assembly immediately before adjournment, and which provides for the substitution of death by electricity for death by hanging in cases of persons convicted of capital offenses. It is likely that the example set by the New York legislature in this matter will be followed in other states. Death by hanging is needlessly brutal and revolting. It is probable that the hanging form was adopted in the first place to make the punishment as ignominous as possible. A hanging in England and in certain localities in America, until a few years ago, was regarded as a spectacular entertainment, a public show for the populace. * * * All this is to come to an end in New York state at least. The execution by electricity will be instantaneous. The infliction of the sentence will be witnessed by only a few persons, officials and such relatives of the criminal as may desire for any reason to be present. The New York law also prevents wakes and public funerals of persons capitally punished. It will doubtless become the model for legislation in other states." The New York *Sun* says: "It is a grave question whether this mitigation of the terrors of the death penalty by a change in the manner of its execution, welcomed by murderers themselves, will be as satisfactory to society. The only justification for continuing that penalty, so abhorrent to modern sentiment, is that, as the most dreadful of all punishments, it acts as the most effectual deterrent from the highest of crimes. If, then, we are to diminish the horror with which it is regarded by abandoning a method of execution universally held to be the most disgraceful, and substituting another more merciful and less infamous in the popular estimation, do we not so far defeat the very purpose of the judicial killing?"

(*Continued from page 297.*)

one. I will read them: — 3.24, 3.1; 2 09, 2 11; 2, 1.9; 2.3, 2; 1.75, 1.6; 1.64, 1.43; 1.57, 1 43; 1.71, 1.61; 1.76, 1.63; 1.4, 1.32; 1.25, 1.11; 1.3, 1.22; 1.3, 1.21. That shows of itself there is a certain law there; it shows that you have developed a series. Then, again, you find in the second series of two that the amounts are generally higher, and in the other a considerable discrepancy and variation; but still those points are very valuable.

Would you also tell us why you prefer not to determine accurately the amount of water that you used for solution? Don't you find, since water is essential; that its chemical equivalent and its relations to the substances in solution should be just as accurately determined, though we are inclined to consider a solution is not a chemical combination? Still, for these purposes, these elements go through combinations through the solution. Therefore, why isn't water essential to be determined?

MR. CROCKER: The water is merely a medium for the action to take place in; that is really the chemical fact. Of course I could put there, in the case of the weights, about how much water an ordinary solution would require, but that really would be merely guess-work. The best you could do would be to find when you obtain the maximum results, and that would be a very difficult question; but I find that it makes very little difference in electromotive force whether a strong or a weak solution is used. It makes some difference, the stronger the solution, the less the electromotive force that amounts to about between 5-100 and 1-10 of a volt; with the concentrated solution, the electromotive force would be that much lower than in a very weak solution. That is because there is so much tendency for the metal to go in solution. The solution is already satisfied; whereas, if the solution is weak, it has an affinity for the metal. That is the way I explain the fact. I intended to bring that out, but that is another series of experiments, and those were all that I had time to undertake.

DR. VANDER WEYDE: Is it not the fact that a certain concentration of a solution to a certain point gives the least resistance? We all know that, for instance, sulphuric acid and water, at a certain degree, is the best conductor. If we increase the water or the sulphuric acid the resistance becomes greater.

In the meantime, Mr. President, while I am up, I cannot refrain from paying a compliment to Mr. Crocker [applause] for his very useful labor. It was just the thing that was needed, and I rejoice that the young man goes in the right direction. It is an investigation in which I was engaged myself some years ago, and I intended to publish some data, but, other business intervening, finding the field so extensive, I despaired of making it as complete as Mr. Crocker has done. I must compliment him [applause].

I wish to make one remark about the use of water—the functionof water in the battery. I would like to hear Mr. Crocker's opinion about a widely adopted theory that the water is the main agent in the batteries—that it is the decomposition of the water that does the work; that the oxygen of the water combines with the zinc and with the metal that is oxydized; and that hydrogen is developed, and a layer is formed which is the cause of polarization, and in order to get rid of that hydrogen the polarizers are applied.

MR. CROCKER: As regards the function of the water in the battery, it is one of those metaphysical points [laughter]. The water may act, and give up its oxygen. The hydrogen may give up the oxygen on one side and turn around and get more on the other side. So far as I can see, it is water all the time. It is not changed, and it acts as a transmitter; that is the most it does. It acts as a vehicle. But after the action is over there is just as much water there as there was before, unless it has evaporated; and in fact some chemical action involved in batteries produce water, and in that case there would be more water at the end of the action than there was at the beginning. Therefore, it could hardly be said that it was used up. Then the action would take place exactly the same in the anhydrous state, whenever it is possible to get that state. For example, with a fused salt the action is exactly the same. The zinc would combine with chlorine in fused chloride of zinc, as I have myself proved by experiment, and give substantially the same electromotive force as it does in the presence of water. Water is merely a means of getting a liquid which it is necessary to have as an electrolyte. Electrolytes must be liquids. Now, you can obtain those liquids by fusing your solid electrolyte, or by dissolving your solid electrolyte. Therefore, I always look upon the water as a means, as a medium, in which the action takes place.

DR. VANDER WEYDE: But the question naturally follows, that if the zinc is oxydized by the oxygen what becomes of the hydrogen at the point of contact with the oxygen? Then there is more than a mere vehicle. We see that the hydrogen is developed at the platinum or silver plate.

PROFESSOR NICHOLS: I would like to supplement Mr. Crocker's statement by an observation in reference to the behavior of iron; and I presume what is true of iron will be true of other metals which form two salts. If you take iron and platinum in a solution which will produce a ferric salt and let the cell stand so that the iron in solution becomes surrounded with a film of its own salt, then the ferric action will gradually cease and ferrous action will take place. After the cell has stood, the electromotive force will rise about one fifth, and you can instantly restore it to the condition it had at first. If you take a porous cell and separate your iron and platinum, put the oxydized solution in connection with platinum, and then around the iron something which will produce the ferrous salt, you will find that that battery has about one-fifth more electromotive force than in the case of the ferric. It seems as though a more successful battery ought to be made with iron producing the ferrous salts. You gain almost enough to make up the difference between iron and zinc; but the behavior of iron is very unsatisfactory, and the reasons for it are not always very clear. It seems as though oftentimes it was due to the formation of oxidizing films which run the resistance of the cells up to an enormous height. I have known the resistance of bi-chromate cells to run up to several hundred ohms in the course of an hour or so by the formation, apparently, of an insoluble film of some form of iron which was almost a non-conductor. Perhaps iron, if worked out patiently, might give us a very cheap metal for a pole of a battery which would reduce the cost of galvanic electricity very considerably.

DR. VANDER WEYDE: I want to state about the cell being an electro negative, that Mr. Crocker is perfectly right in that.

DR. MOSES: The remarks of Prof. Nichols recall to my mind some experiments which he perhaps has overlooked, but which he made quite a number of years ago, in which he used, if my memory serves, zinc, in a sulphate of copper solution, where the variation of temperatures produced considerable variation. I would like to inquire whether that was not due to the formation of salts of variable solubility around the electrode?

PROFESSOR NICHOLS: It might very easily be.

MR. MAILLOUX: I would like to ask what appears to me a somewhat pertinent question in view of the discrepancy observed between the calculated and determined electromotive force, and that is about the standard which Mr. Crocker used — what value he expected for it, and upon what authority, so that we may know what kind of a volt he used.

MR. CROCKER: That is an important point, of course, because everything depends upon that. I used constantly Daniell cells, but independent ones set up separately, and with commercially pure sulphate of zinc and copper — commercially pure metals — half saturated. Then I further checked the results by two electromotive forces which I happened to know and had previously determined very many times, and those are the bromide combination of zinc and the oxide. That in itself is an excellent standard cell — free bromine and zinc. It gives an electromotive force of 1.79 volts. That is the result, I suppose, of a thousand experiments carried on with a certain object. Therefore, in going through my experiments, when I came to the combination zinc-bromide and found that it gave an electromotive force of 1.79 volts, I felt perfectly at home, because I had been there so often before, that it corroborated my standard. Then the combination of zinc and chlorine, 2 11 volts is also very frequently determined, and of the Upman battery, which came out about a year and a half ago in England, the published electromotive force of which was 2.11 volts. So there were several corroborative facts. So far as my experience goes a standard Daniell does not vary very much in electromotive force. Mr. Howell, I suppose, could tell more about that.

PROFESSOR THOMSON: I would like to say just one word on this subject. It has been probably a common experience of those having Daniell cells in operation to notice, if the solution is not kept up to a high degree of strength, that oftentimes the upper part of the copper will be eaten out, and the electrolytic deposit of the copper made in the lower part of the cell where the solution is strong; or, in other words, there is an indication of a difference in the volts which carries on a sort of plating action on the copper plate itself. Whether this be due partly to the effect of the acid, or that the solution comes through from the porous cup and floats on top, causing a difference in the electrolytic condition of the fluids alone, setting up current, I do not know. But it recalls to my mind an observation several years ago on the effect of simple heating of the solution, putting at the lower part of the test tube a little spiral of copper wire and carrying out a connection by an insulated covering from that spiral filling up the test tube partly with sulphate of copper solution; putting another little spiral near the top of the fluid and then heating; we find a difference of voltage, and it amounts, I think, to something over one-tenth of a volt, or rather something over one-twentieth of a volt, if I remember the result of the experiments correctly, showing also that a solution — if we short-circuit such a battery — a solution of the copper will be expected to take place and a deposition of the copper in the cold liquid. In other words, the hot liquid is more of a solvent than the cold, although it is a sulphate of copper solution. Whether Mr. Crocker has taken into account the temperature of the solutions in making the tests, I do not know.

MR. CROCKER: I made the tests at the normal temperature. It did not vary 5 degrees from 68; I do not think it varied more than three or four degrees. What Professor Thomson says about a hot liquid giving electromotive force with a cold liquid, as it were, is true. In fact, Mr. Bradley has a battery which works on that principle, giving quite an electromotive force — I could not say exactly what, but quite a fraction of an ohm and he depends, to a certain extent, upon the heat of the solution; and that is a very interesting, and, possibly, a productive field for investigation.

PROFESSOR THOMSON: It is probably well understood, nowadays, that all the elements are not to be considered as real elements as we find them. I do not mean that they are decomposable into hydrogen, although I think that quite possible and, perhaps, even to a far more primitive condition than hydrogen if we could use forces which we have not at hand. I mean the celestial forces. I mean that each particle of copper known to us is a combination of copper with copper; that the atom really forms a molecule which is a real compound. Two or more atoms may be found united, but it will certainly take something to decompose those molecules, even though they be combinations of the same atoms. I am struck with the results obtained with aluminium in the work of Mr. Crocker. We find actually that this metal, so hard to get at, is really capable of giving an electromotive force less than zinc; so that it would seem as though by the proper use of zinc in some way or other, we might separate aluminium. In other words, its electromotive energy is very much less than zinc, and, in some cases, not very much different from iron.

(*To be continued.*)

CORRESPONDENCE.

New York Notes.

NEW YORK, June 9.—The next meeting of the American Institute of Electrical Engineers is announced to be held at Columbia college on the evening of June 19th, when a paper will be read by Lieut. Frank J. Sprague, the subject of which is "The Problem of Municipal Rapid Transit Solved." The topic is to be exhaustively treated, and in a popular manner, so that it will be of unusual interest to all classes of engineers as well as the general public. A large number of views and diagrams illustrative of the subject are being prepared, to be shown through a lantern, and the occasion promises to be one of the greatest interest. Invitations will be sent to the members of the various engineering societies residing in the vicinity of New York, where the interest in rapid transit is nearly if not quite as great as it was before the establishment of the elevated railways, which are generally acknowledged as being entirely inadequate to the present demands upon their facilities.

Ex-Assemblyman O'Connor appeared before the Board of Electrical Control on Friday to protest against the stringing of any more electric light wires, on the ground that when the bids of the various electric light companies for public lighting were before the Gas commission the bid of the New York Illuminating company was withdrawn under pressure from the representatives of competing companies, and that its bid was 25 cents per night as against 35 cents by other companies for non-competitive points. No authority exists for the withdrawal of such bids, and it appears that the formality of advertising for proposals must again be gone through with. The papers of a suit were to be filed this morning in the Court of Common Pleas, the object of which is to set aside the contract awards and to compel the commission to readvertise. Mr. O'Connor makes no charge of corruption, but claims that it is a dangerous precedent to establish.

John O'Brien, a lineman employed by the Metropolitan company, was arrested on June 7th and charged with having attempted to string a wire along Broadway without a permit from the board. When the officer asked O'Brien for his permit he showed one signed by Secretary Moss authorizing him to stretch a wire from No. 72 West Thirty-ninth street to No. 47 Third avenue, but not mentioning Broadway. He also showed a piece of paper marked "'O K.' Moss." When the latter document was shown the case was at once abandoned. It subsequently appeared, however, that this sign-manual was simply a private pass given to the man to secure admission to the roof of the theater building of which Mr. Moss is the lessee.

The Metropolitan Telephone and Telegraph company has just placed on the market its issue of first mortgage gold bonds to the amount of $2,000,000, drawing 5 per cent., and running thirty years. They are liens on all real estate, rights-of-way, lines, and apparatus. As the company is earning $600,000 per year, and the money to be raised is for the improvement of very desirable real estate, the investment may very properly be considered gilt edged; if not, the indorsement of the parent company could no doubt be readily secured.

The new laboratory of Mr. Edison at West Orange is already becoming a Mecca for the Jersey school teachers. The Essex County Teachers' association visited it last week to the number of 120, and spent a couple of hours very pleasantly in inspecting that interesting establishment. They subsequently held a meeting for the election of officers in the library, and passed a vote of thanks to Mr. Edison and his employes.

The incandescent gas-light people are now making an appeal for financial support through the solicitation of subscriptions to their stock. The Welsbach company led off, but was followed up immediately by the Lungren company, which claims to hold all the patents of any importance. The Welsbach people have rooms on Twenty-seventh street, where the advantages of the system may be seen by visitors who are interested. These burners are not considered superior to the incandescent electric lamp, but are expected to aid materially in holding the ground already occupied by the gas companies, many of whom are becoming somewhat anxious as to the possibilities of electricity in the future.

Count Mitkiewicz, who made quite a stir nearly a year ago in connection with his alleged telephone concessions in China, has again appeared before the public as complainant in a suit brought against Wharton Barker, at Philadelphia, in which he charges the latter with having broken up his scheme. The count shows in his bill that in March, 1887, he had a partner in William L. Paine in his efforts to secure concessions for a telephone system in China. They afterward took Mr. Barker into their confidence. The count was to have a 3-20th interest, Paine 4-20th, and Barker 13-20th. The telephone company was to have a capital of $6,000,000, $1,000,000 of which was to be limited to Chine e subscriptions, the remainder to be owned by a company to be formed with a capital of $20,000,000, to be called the Oriental company. P.

Minneapolis Mention.

MINNEAPOLIS, MINN., June 9.—The Minnesota Brush company's station in Minneapolis is an exceedingly interesting establishment to visit, especially to one appreciative of refinements in mechanical and electrical processes. It is replete with novel features indicative of comprehensive mechanical ability coupled with electrical engineering, the result being a model lighting station. The building is placed on the bank of the Mississippi river, in the center of which a crib has been built, thus insuring a never failing supply of water for the condensers. Several lines of railway tracks are within a few feet of the station, and a siding is laid whereby fuel is transferred from the car direct to its receptacle with a minimum amount of handling.

Ashes are wheeled from the furnaces to the river side and dumped there to build up a solid and permanent bank. The station being located very near the center of the city, all of the first requisites for a station site are fulfilled, namely: Minimum expense of handling fuel and refuse, abundant water, and central location. On the ground floor of the station are located the boilers, engines, pumps, shafting and pulleys; on the second floor are the lamp-room, superintendent's office and dynamo-room, which are all light, commodious and roomy compartments. The battery of boilers consists of seven 60" x 16 tubular boilers of 125-horse power each. For the past four months experiments have been conducted for substituting crude oil for coal as fuel. The Chief Engineer, Robert Williams, while being naturally conservative and not inclined to jump at conclusions, has become an enthusiastic convert to the new system, and in glowing terms vouches for the advantages of crude oil fuel as compared to coal. Five of the seven boilers are now fitted with the oil burning apparatus, and there has been demonstrated a saving of 35 per cent. in the cost of fuel for these five boilers, and 50 per cent. saving in labor of caring for the boilers. The absence of dust, dirt and soot in the boiler-room is very noticeable. It is necessary to clean the flues only once a week instead of every six hours; and outside of natural gas it is the only practicable method of complying with the smoke ordinance. The operation of two valves regulates the heat to a nicety from no fire to as intense a heat as the boilers will stand, and has proven to materially increase the capacity of the boilers. Mr. Williams has spent a large amount of time and study over the problem on which so many are working, and to him is largely due the credit of perfecting the details apparently so successful. For storage of the crude oil two immense iron tanks are being placed in the ground just outside the station walls. These tanks rest on masonry foundations, and are nearly buried, only their inlet orifices appearing above the surface of the soil. They are located parallel to the fuel siding, and tank cars will discharge their cargo by gravity into the storage tanks. The tanks each have a capacity for 325 barrels, or a total for the both of nearly 30,000 gallons. The tanks are surrounded by steam coils to prevent chilling of the oil in cold weather. The oil flows into the boiler room by gravity pressure though a system of underground piping connecting the tanks. The engine capacity of the station is an aggregate of 600-horse power, all Reynolds' Corliss engines—a pair of 275-horse power engines, and one each of 175 and 150-horse power capacity respectively; all are worked condensing. The engines are placed side by side and drive the parallel lines of shafting. All three lines of shafting extend across the entire width of the building, the driving belts for the two further lines of shaft being carried down beneath the floor by means of pulleys. This forms rather a novel way of transmitting large powers and allows a symmetrical disposition of shafting and dynamos. The dynamo pulleys on the shafting are all friction clutch pulleys of the Hill pattern. The clutches are thrown out and in from the dynamo room floor above by means of a vertical rod extending up through and just flush with the dynamo room floor. A large socket wrench is applied to the upper end of the rod whenever it is wished to throw a clutch in or out. Applied to all the line shafting is a very neat automatic oiling device which effectually prevents the occurrence of hot boxes. In the roof of the station is placed a small oil tank, and from this tank is brought down an iron pipe which branches to a horizontal pipe placed over and parallel to each line of shafting. From these horizontal lines of pipe a small piece of pipe with a pet cock on the lower end is carried down to each journal on the shaft. The drip from the journals is caught in a pipe which carries the oil to other lines of horizontal pipe at the floor level. The latter horizontal pipes all converge to a filter. Thus, from the tank in the roof the oil is led to the journals, and from the journals through the filter, by gravity pressure alone. The oil from the dynamo bearings is also piped to the filter. A small one-horse steam pump elevates the oil from the filter to the tank in the roof. The oil is used over and over, the slight wastage being more than compensated for by the new oil coming constantly from the dynamo bearings. An attendant takes an occasional trip among the shaft journals and adjusts the supply of oil by means of the individual pet cocks, or shuts it off entirely when the shaft is at rest. The cost of the apparatus is quickly returned in the great saving of oil and the entire freedom from heating of journals.

The dynamo capacity of the station is seventeen 65-lighters and one 30-lighter. Two of the 65-lighters are running on motor circuits, of which there are fourteen in use, aggregating 65-horse power. For the large powers Brush motors are used, and for small powers Baxter motors. About 900 full arc lights are run from the station, and 1,300 incandescent lights on the series multiple system. Twenty circuits run out from the switch board with a total of about 150 miles of wire in circuit. The circuits are constantly being increased by the addition of both arc and incandescent lights. The Leighton saw-mill has recently been wired for ninety six and the McMullen saw mill for eighty incandescent lights, both on the all-night circuits. The ceiling of the dynamo room is fitted with a system of hanging tracks on which run traveling carriages. To the carriages are swung differential blocks and chains by which armatures are quickly and conveniently handled. The time consumed in taking an armature from the packing case and putting it in a dynamo is very brief. M. J. Mershon, superintendent, ably assisted by Geo. B. Short, foreman, preside over a dynamo room which is a model of neatness and arrangement, and their affable treatment of visitors makes an inspection of the station a pleasure to be remembered. The business of the company is ably handled by S. S. Leonard, general manager. Taken all in all the Minnesota Brush Electric company's station presents many points of economical and convenient methods and arrangements worthy of consideration and adoption by companies operating station lighting plants.

The Minneapolis Electric Construction company have been awarded the contract for furnishing electric bells in the New Globe building on Fourth street, consisting of two elevator annunciators and an annunciator in the engineer's room to call from the several corridors. They are also to furnish the electric bells in the large tenement block now being built by O. S Buell; and quite an extensive outfit of electric bells and gas lighting for P. W. Herzog.

A. S. Huey, of the Edison company, a few days since took a run out Duluth way, looking after the interests of his company

T. A. Hughes, electrician for C. A. Pillsbury & Co., is reported to be in Washington and Baltimore securing and introducing an electrical patent.

A. H. Gibbon, electrician for the Washburn Mills and elevator property, has recently returned from Duluth, where he went to inspect the incandescent light plant installed in the Duluth Elevator company's elevators by the United States Electric Lighting company. Mr. Gibbon reports the plant as being the finest elevator plant in the northwest and giving the best of satisfaction. Mr. Gibbon, in his capacity of electrical engineer and inspector, has under his supervision about 1,500 lights distributed among a number of mills and elevators, and to Mr. Gibbon's intelligent care is largely due the excellent satisfaction all of these lights are giving.

Bell & Co. are laying in a large stock of all sizes of wire of the New York Insulated Wire company's manufacture. They have also added to their varied stock a fine line of telegraph instruments and supplies. An important branch of their business is construction work and general wiring for all kinds of electrical appliances from battery current They are now figuring on several large jobs of this sort of work.

T. M. Maguire, mechanical and electrical engineer of the Syndicate block, recently made up a statement concerning the operation and service of the incandescent plant in use in the block. The system is the United States Electric Lighting company's, consisting of four dynamos of a total of 1,500 lights capacity. Two New York Safety Steam Power company engines furnish the motive power, belted direct to the dynamos. The Grand Opera house is lighted from this plant, as well as the two best lighted stores in Minneapolis, namely, the Syndicate Clothing Co., and Bradstreet, Thurber & Co. Mr. Maguire states that the Grand Opera House is the finest lighted theater in the northwest, and J. F. Conklin, manager of the Grand Opera house, heartily concurs in this and emphasizes it with the affirmation that the United States Electric Lighting company's system is the very best for theater lighting.

The high art furnishing establishment of Bradstreet, Thurber & Co. is lighted in a manner at once unique and ornamental and produces a beautiful effect from both exterior and interior. Among the gratifying results, Mr. Maguire's statement showed an average life of 1,050 hours per lamp. Mr. Maguire is the Minneapolis agent for the New York Safety Steam Power company's engines, and reports the inquiries good for that class of engines.

The DYNAMO TENDERS' HANDBOOK is for sale by J. H. Hurlburt, Gilfillan block, St. Paul, where subscriptions are also taken for the WESTERN ELECTRICAN. H.

Little Rock, Ark., Asks for Light.

LITTLE ROCK, ARK., June 7.—The city is advertising for bids for lighting the city with an arc electric light plant and four towers with 100 arc lights of 2,000-candle power each, the plant to be first-class in every respect and fully equipped. Bids are also asked for lighting the city with four towers and 100 arc lights for two years. Bids may be made on either or both propositions, and will be opened at noon, Monday, June 25th.

The Interstate Railway Construction company has been incorporated. The capital stock is $500,000; James B. Simpson is president. The object is to build railway, telegraph and telephone lines in Arkansas, Texas and Louisana. K.

St. Paul News.

ST. PAUL, Minn, June 9.—The St. Paul Electric Light & Power company is a new incorporation organized for furnishing commercial and street lighting for West St. Paul, South Park and South St. Paul, covering all the territory on the west side of the river. The officers and directors are: President, J. H. Lawrence; vice-president, W. Willett; secretary, James Walsh; treasurer, A. M. Lawton; general manager, Henry Henley. These gentlemen also compose the board of directors. The authorized capital is $200,000. The company purchased of the Eureka Improvement company the lighting and power plant located at South Park. They at present are running a 45 arc light plant—Thomson-Houston system—and also furnishing power for the Enos elevated electric railway. Mr. Henley is negotiating for increasing the capacity of his station by the addition of a 1,000 light incandescent plant. A territory from one to two miles wide and eight miles long is to be covered with the incandescent system, although the bulk of the lighting will be in West St. Paul, which is about five miles from the station. The station is located upon the river bank in a temporary building and the motive power is two boilers and a Buckeye engine. A large commodious station will be built in the near future to accommodate the increased capacity contemplated.

The electric light plant in the state capitol building was started this week and moved off very smoothly. A few minor details are not yet completed, but when finished the plant will be one of the most perfect and handsomest installations in the northwest. No expense has been spared to make the plant as ornamental and complete in all its details as was possible to attain. The switch-board and mouldings are of oak, natural finish, and beautifully carved and fitted. The instruments, electroliers and fittings are sightly, finely finished and conveniently arranged. Two dynamos of 650 light combined capacity are in service, 104 volt lamps are used, and provision is made for attaching the system to the Edison station system in case of a stoppage of the power plant. Two Hawkeye electric motors are placed in the tower of the capitol building, connected to the lighting mains, and furnish power for driving two large ventilating fans The lighting system is that of the Mather electric company, and the work has been done under the supervision of F. C. Turner, general northwestern agent for the company. Mr. Turner is to be congratulated for making so successful and elegant an installation. The Mather company also has a large plant in the Blair flats, furnishing lights to all of the apartments and stores of the building and in a number of adjacent buildings. The Blair plant ranks as one of the finest isolated installations in St. Paul. The new office building of the St. Paul, Minneapolis & Manitoba Railway company, corner Third street and Broadway, is being wired for an 800 light plant by Mr. Turner, for the Mather company.

The power house of the St. Paul Cable Railway company is lighted by a 200 light incandescent plant, Excelsior system. In appearance the dynamo is a fac-simile of the English Allen machine, and Brush Swan lamps are used. The plant was set up and wired by B. H. Leveridge of the St. Paul District Telegraph company, and is giving good satisfaction.

The telephone company is rebuilding its Selby avenue line, replacing 30 foot poles with a fine lot of 45 foot poles. The local manager, Mr. Joyce, contemplates a very laudable move, that of giving each of the girls of the exchange a vacation, probably of two weeks' duration each. In a busy office like that of the St. Paul company the girls must be constantly on the alert, and nine or ten hours of unceasing vigilance is wearisome. A vacation of rest and recreation will prove a delightful novelty from the infinitely abused "hello" to gum chewing. The solace of gum chewing is prohibited the girls while on duty, but the toothsome morsel will suffer during the coming summer when the telephone girls have their vacation.

E. R. Gilman of the Thomson-Houston company has recently returned from a business trip to Chicago.

Henry Henley, of the St. Paul Electric Light & Power company, is taking in Cincinnati and other points investigating the subject of incandescent lighting.

J. H. Woolsey, of the United States Electric Lighting company, has returned from a tour through central Wisconsin.

C. H. Wilmerding, representing the Northwestern Electrical Accumulator company, was in the city the early part of the week.

A. W. Butterworth, for the Callender Insulating and Waterproofing company, showed samples and quoted prices in St. Paul a few days since.

H. B. Warren, in the interests of the United States Electrical Lighting company, visited various points on the shores of Lake Superior the past week.

Jason Hidden, manager of the Minneapolis Electric company, recently returned from the east and visited St. Paul friends. Okonite wire moves steadily to the front under the pilotage of Mr. Hidden.

A smoke ordinance has been passed by the council of St. Paul looking towards the abolishment of the smoke nuisance. Certain portions of the city are excepted, comprising the wholesale and manufacturing districts and the railway yards, but in the district not so excepted are located the three electric light stations, namely: the gas company, the Economy Steam Heat company, and the Edison company. How the ordinance will be enforced in respect to these three important fuel consumers, and if enforced what methods will be pursued in observing the ordinance, will prove a matter of much interest. On these beautiful summer evenings a magnificent picture of the city is obtainable from any of the picturesque bluffs surrounding the city; the only blots on the fair view are the three dense clouds of inky smoke constantly belched forth from the stacks of the institutions named. Other manufacturing industries are shut down for the night, railway locomotives are nearly all housed, what few are in operation only adding the requisite amount of animation to the scene to prevent an appearance of absolute inactivity, and the air takes on a rural transparency and pureness. The billowy masses of floating carbon disfigure alike the fairness of nature and the handiwork of man. So much from an esthetic standpoint; practical considerations are too well known to need comment.

The council also granted permission this week to the National Conduit company to lay their conduits in St. Paul. In a quiet way the matter of forcing all wires underground is being agitated. W.

Kansas City, Mo.

KANSAS CITY, MO., June 9.—The board of police commissioners is renewing its efforts to secure a system of police patrol boxes. They are hampered in many respects but mainly by the fact that the appropriation for the present year is no more than enough to sustain the force with its present equipments. The board has assurances that it can secure and maintain for one year 100 patrol boxes for $5,000, and indeed the Home Telegraph and Signal company of this city, representing the Police Telephone and Signal company of Chicago, has already submitted a bid to that effect. Additional boxes will be furnished at the rate of $42 each per year. The system which the company proposes to put in is the same which is in operation in Chicago, St. Louis, Cincinnati and elsewhere. There are about 1,800 blocks in the city, and it is proposed to place a patrol box in the centre of squares of twenty-five blocks or more, depending on the character of the district, and one at each corner of the squares. It is believed by this wide distribution 100 boxes can be made to answer the present needs. The manner of raising the necessary $5,000 has not yet been discovered. Chief Speers, of the police force, has suggested to the board that with the patrol boxes in operation there will be little use for the mounted police, and estimates the receipts from the sale of the horses, the saving of the pay of stablemen, the cost of feed, etc., will give the board $3,600, and that it can squeeze the remainder out of the general appropriation. The chief is of

the opinion that at a pinch it would be better to reduce the force than do without the patrol box system. He believes that if the system had been in operation here last winter during the operations of the foot-pads, which resulted in numerous street robberies, several assaults and two or three murders, the murders would have been prevented and the foot-pads arrested.

The application of electricity to public service is also being extended in the fire department. Kansas City has never had any other fire alarm system than that furnished by the telephones. This has proven so successful that Chief Hale says he would not allow an electric fire alarm system of the usual kind in operation to be put up here free of charge. Heretofore when a fire was discovered, the alarm was immediately telephoned into the exchange and the operator at the exchange notified the fire department. There were delays sometimes by the inability to obtain the ear of the operator at the exchange. About two years ago Chief Hale suggested to the electricians of the telephone company, Messrs. A. Barrett and Joseph Zentner, to devise some plan by which the alarm could be sent directly to the fire department. Since then the electricians have been working on the idea and have only lately perfected a device for accomplishing what is desired.

The plan involves a loop or series of loops through different parts of the city direct to the engine house. The loop can be tapped by any number of telephones. The actual invention consists of a box about four or five inches in dimensions, containing two electro-magnets. The box stands right in the exchange line. An armature is so placed that by the action of a lever the telephone is thrown in direct connection with the loop extending to the fire department. When the lever is pulled down the armature makes connection with the front contact, which is part of the fire alarm circuit, establishing a complete circuit from the fire department to the subscriber's station, where the lever is pulled. Between the fire department instrument and the ground are placed the batteries which send the current through the magnet at the subscriber's station, holding the armature upon the electro magnets until it is released by the operator at fire department head quarters. To restore the subscriber to his exchange line, the operator at fire department merely presses a button which short-circuits the battery and releases the armature. The box may be placed at a distance from the telephones so that the fire department may not be unwittingly called up when only "central" is wanted. Each box contains a register throwing a number into view every time the lever is pulled down, acting as a check on any tendency to "monkey" with any fire department. An important fact in connection with this system is that if the telephone exchange were to be destroyed this would still operate as a fire alarm. Strong efforts are being made to have the city appropriate an amount sufficient for the manufacture of enough boxes to supply the business portion of the city and have the system given a fair trial.

The ability of the telephone in Kansas City to act as a fire alarm can be judged from the fact that there are 2,425 telephones in operation in this city. Only seven other cities have more telephones than this. Chicago is one of them. St. Louis is not. St. Louis has only 2,070. There is no great demand for quick and frequent communication in St. Louis. Besides, there is a respectable minority in St. Louis that believes the telephone an invention of the devil and an irreverent innovation to be frowned down. But Kansas City excels all cities in the use of the telephones she has. The first syllable uttered in Kansas City in the dim gray of the morning's dawn is "hel," and the last that salutes the twilight memory of the day that was, is "lo." Each of the 2,425 patrons of the telephone in Kansas City call up "central" on an average twelve times a day. In no other city does the average exceed eight times.

There are besides thirty toll stations connected with this exchange, an increase of ten over the number a year ago. The farthest exchange is 138 miles away.

The Kansas City Electric Light company will soon have 3,100 incandescent lights in operation and 850 arc lamps, that is, it is fully prepared to operate that number, and as the demand is rapidly approaching that number, it is fair to say that the company will soon be operating that number. Then something will have to be done because there is going to be a demand for more lights still. The alternating current sustains 1,500 incandescent lights, and the direct current 1,600. This company has recently secured the contract for lighting the new Midland hotel. This contract calls for 1,000 incandescent lights and 15 arc lights.

Two new $75,000 electric light plants are to be established here if the statements of those interested in them are to be believed. One will be that of the Hallett Electrical Illuminating and Power company; the other that of the Interstate Electric company. The latter will be an accumulator plant. The Hallett plant will be located at Twelfth and Franklin streets. Buildings will have to be erected for the plant. The Interstate's plant will be in the basement of the $350,000 building now being erected at the corner of Ninth and Walnut streets by the Keith & Perry Coal company. Boilers are being put in of 400-horse power, and the final capacity of the plant will be 10,000 incandescent lights.

The Kansas City Steam Heat, Light and Power company will, in addition to furnishing steam heat and power, furnish electric light and power. It has not begun operations yet, confining itself entirely to the work of surveying and planning. It proposes to be the biggest thing in town, and its preliminary appearance has a tendency to convince one that it will be what it proposes to be. The company will establish a steam plant of 3,500-horse power, and four electrical plants of a light capacity of 10,000 incandescents and 1,000 arcs. But it expects to operate also many electric motors for elevators, etc.

The Kansas City Electric Light company has the contract for lighting the tunnel of the Interstate Elevated Railway's cable line, which extends from Bluff street to Pennsylvania, about 800 feet. The tunnel will be lighted automatically by an original plan. The main point about it is that as the cable train enters the turn an attachment to the top of the car, shaped like a V, will connect the wires necessary to complete the incandescent light circuit, and the tunnel will remain lighted until the car leaves it, when, as the V is withdrawn, the circuit is broken and the lights are out. A.

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KANSAS CITY, Mo., June 9.—The Interstate Electric company of this city are the western agents for an accumulator system of electric lighting, and are pushing this branch of their business, which is growing rapidly. The company are now announcing to the business men of this city the installation of their new plant in the Keith & Perry building at the corner of Ninth and Walnut streets, from which point they will be ready within the next thirty days to furnish light or power at the pleasure of the consumer, night or day.

O. W. Ditsch, superintendent and electrician of the American Electric Light company, left Wednesday night for a two months' tour through Germany, England, and France. Mr. Ditsch is one of a party of four gentlemen, all of this city. In the course of their trip they expect to visit Hamburg, Berlin, Strasburg, Frankfort, Paris, and London. The party sail from New York city on the 14th inst.

Chas. A. Rolfe, special agent of the Gamewell Fire Alarm company of 118 La Salle street, Chicago, was in the city last week on business for his house.

Among the visitors in the city this week were W. H. McKinlock of the Central Electric company of Chicago, and W. L. Candee, treasurer of the Okonite company. This company have made such arrangements that their agents in this city and Omaha can get their supplies direct from Chicago instead of New York.

L. H. Horton of New York was in the city last week on a prospecting tour.

The Hiawatha Electric Light and Power company of Hiawatha, Kansas, will decide on a system of incandescent lighting Tuesday next. There are a large number of bids in.

C. H. Cone of the Electrical Supply company is on a trip through the west. D.

From Topeka, Kansas.

TOPEKA, Kan., June 9.—Work is progressing rapidly at the new electric works of the city. The steam pump made by Dean Bros., of Indianapolis, Ind., has been placed in position and tested, proving eminently satisfactory. The boilers are in position and the foundations are ready for the dynamos. Superintendent Reilly says that unless something now unthought of occurs the city will be brilliantly illuminated on the night of June 11th. There is already a strong demand for thirty or forty more lights than the present capacity of the plant will furnish, and the city council is seriously debating the question of issuing bonds and purchasing an additional 75 horse power engine and two dynamos, which would entail a total expense of $13,500 and increase the number of lights by sixty.

Oakland Grove, the new pleasure resort, is furnished fifteen arc lights by the local Brush Electric Light company.

An electric lock has been placed on the door of the cash room of the state treasury. The touching of any of three buttons located within the reach of the treasurer and his deputy and clerks locks the doors instantly and they can be opened only by pressing another button.

An informal communication was received at the last meeting of the council from the Brush Electric Light company in relation to furnishing lights for the streets. The communication stated that the company would contract to furnish "fifteen lights in the Third ward for seventy-five cents per night on one year contract; on a three-year basis, fifteen lights, fifty cents; sixty lights, thirty cents; ninety lights, fifteen cents; one hundred and ten lights, five cents; one hundred and twenty lights, free." The mayor remarked that he thought 120 lights would about meet the requirements of the city. But as the communication was not in the legal form of a proposition the last and generous offer of the company could not be accepted, but a resolution was adopted providing for the city negotiating with the Brush company for electric lights for the streets and appointing a committee to conduct the business and to report at an early date. C.

Enterprising Kansas Towns.

ATCHISON, Kan., June 9.—For some time past it has been known that negotiations were pending for the formation of a new company, with the view of purchasing the plants of the Atchison Gas company and the Electric Light company. These negotiations culminated during the past week in the purchase of both of those installations by the Atchison Gas, Electric Light and Power company. The new company is chartered under the laws of the state, and is virtually the old gas company. The directors are J. P. Pemeroy, A. G. Otis, James M. Chisman, J. P. Brown, and E. S. Wills. The new company is officered as follows: President, J. P. Pemeroy; vice-president, A. G. Otis; treasurer, R. A. Park; secretary and superintendent, James M. Chisman.

The deeds show that the Atchison Electric Light and Power company transferred to the Atchison Gas, Electric Light and Power company all its real estate, franchises, and personal effects for a consideration of $50,000, and that the Atchison Gas company, as above indicated, sold to the new company all its effects, franchises, etc., for a consideration of $200,000.

It is the intention of the company to immediately make extensive improvements, for which arrangements have been already made.

The improvements contemplated include a separate incandescent light system and powers for the machinery in factories throughout the city.

CLAY CENTER, Kan., June 9.—A. F. Dexter is arranging to put in an electric light plant here. He has just returned from a trip to Kansas City, Mo., where he witnessed the operations of the storage battery system, and was favorably impressed.

WICHITA, Kan., June 9.—The manager of the local telephone exchange has received a letter from the president of the Missouri and Kansas Telephone company, stating that the painful lack of telephones in the city would soon be remedied. There are at present over one hundred orders on file, and more orders will be given as soon as it is seen that the telephones will be put in.

The Thomson-Houston company has obtained the contract for constructing the Wichita, Riverside and Suburban Electric railway for two miles. If this proves satisfactory, three miles more will be built. This is the contract which it was first announced the Sprague company had secured.

OSWEGO, Kan., June 9.—The Oswego Electric Light company has let the contract to the Kansas City, Mo., agency of the Thomson-Houston Electric Light company for thirty arc and five hundred incandescent electric lights.

BELOIT, Kan., June 9.—This city is becoming wild for an electric light plant. At present a delegation of citizens is visiting the neighboring towns where electric light plants are in operation for the purpose of ascertaining which is the best system. Bonds will probably be voted and a plant established before the season closes.

EMPORIA, Kan., June 9.—The electric light plant here was struck by lightning the other night, and the city has been compelled to return to gas. There are fears that the heavy rains, if continued much longer, will drown the water-works.

KANSAS CITY, Kan., June 14.—Ben Freidburg, after waiting almost a year, has at last secured from the city council a franchise for an electric light system. He will begin work on his plant at an early day, which will involve an outlay of $25,000. Under the franchise Mr. Freidburg will rent an arc light for $12, a cut of $5 on the Kansas City, Mo., companies' charges.

William Fletcher has also been a seeker for an electric light franchise, and in the last meeting of the council, at which Freidburg was successful, made the statement that Freidburg had offered him a sum of money to withdraw his application. Freidburg denounced this as a lie, and the dynamos immediately began operations. Chain lightning, alternating currents, arcs, incandescents, high and low tension batteries, accumulators, et cetera, et ceterum, flew back and forth for the next few moments, but the sergeant-at-arms acted as a non-conductor when interposed between them, and thus prevented mutual annihilation. D.

From St. Louis, Mo.

ST. LOUIS, Mo., JUNE 9.—The Bell Telephoue Co., continues to remove the telephones from subscribers' premises as fast as their contracts expire. The decision in the test case which will be carried to the Supreme Court can not be reached before October. Nearly three-fourths of all the instruments will have been removed by that time should the company still continue its present plan. Mayor Francis ordered the street commissioner Wednesday afternoon to remove the wires and poles as fast as they were abandoned by the company.

The company claims their authority to do business comes from the state, not the city, and hold that the city can not remove their poles; if such a thing were tried the company will seek relief in the state courts. Street inspector Murray reported the poles on the west side of Twelfth street between Clark avenue and Chestnut as not in use and could be removed without interfering with any other company. The city will move slowly in this matter as the street commissioner says they can not remove the telephone poles on a great many streets, as they are occupied jointly by the telephone, electric light and fire alarm wires.

There is considerable talk of a large incandescent plant for this city, low tension direct current to be used. A $50,000 plant is the size talked of.

The Brush-Julien motor car on the Washington avenue road is again running. Electric motors are in great favor with the people of St. Louis.

There is a 250 light United States plant going in the building at the corner of Sixth and Olive streets, for the use of the E. Jacard Jewelry company.

The Mercantile Library plant will be started July 1st. The non-arrival of the engines will make it impossible to start it any sooner. B.

Missouri Messages.

ST. JOSEPH, Mo., June 9.—The telephone company is busily engaged in replacing its numerous wire cables wherever possible. Superintendent Yenawine reports 650 subscribers at present.

One morning during the past week the telephone wires on the Savannah extension became crossed with the wires of the Union railway's electric line, and the telephone system came very nearly being knocked out. Two telephones were burned out in less time than it takes to tell it, the switch board at central station was set on fire, and the girls were panic stricken. Prompt measures prevented trouble, however.

The convention of the Southwestern District Train Dispatchers was held here during the past week. The following officers were elected for the coming year: President, I. T. Dyer of St. Joseph, Mo; vice president, John Fleming of Trenton, Mo.: treasurer, W. R. Robinson of St. Joseph, Mo.; secretary. A. G. Smart of St. Joseph, Mo.; executive committee, W. Clinton, chairman of Eldon, Ia.; B. Bean, of Brookfield, Mo.; H. B. Ware, of Lincoln, Neb.; delegates to the national convention in Cincinnati, June 12th, H. H. Libby, H. B. Ware, L. B. Carroll, W. C. Sutherland.

The Union Railway company is pushing the work on the electric equipment north of the Market square. A large

force of men is engaged in laying the double track. The poles are in position along the entire route and the work of stringing the wires has been almost completed. It is expected that operations can be begun within ten days.

BOONVILLE, Mo., June 9.—C. B. Rhodes was recently voted by an overwhelming majority a franchise for an electric light system, and has begun work upon his plant. Thomas B. Wright, representing the gas company, has served notice on the council that he intends to test the validity of the election on numerous grounds. The prospects for a long and tedious fight are good. Mr. Rhodes intends to go right ahead with his plant and stop only when compelled to do so which he thinks will never be as the result of the action of Mr. Wright.

MOBERLY, Mo., June 9.—The construction of an electric railway is being strongly agitated here.

LEBANON, Mo., June 9.—Lebanon has been moving along for many years steadily advancing, but still attracting no special notice from the outside world. The other day a prospecting well was sunk here, a vein of water was struck, and the machinery and pipes were found to be magnetized. Since then thousands from all parts of the country have visited the city, and the news of its magnetic well has been wafted on every breeze to all parts of the country.

The magnetic influence is so strong that all the iron and steel of the machinery connected with the pump has became thoroughly magnetized; a piece of steel rubbed on any of the iron connected with the pipes will soon become sufficiently charged to pick up a common nail, and by taking hold of two pieces of iron, each touching the pipes so as to form a circuit, an electric current is detected. A knife blade warmed and inserted in the water becomes readily magnetized.

The water possesses highly curative powers for such diseases as rheumatism, etc. The proprietors of the well have already let the contract for building a large bath house, and it is proposed to erect an extensive sanitarium here at an early date.

Professor E. M. Shephard of Drury college, Springfield, Mo., has analyzed the water and found but 55 per cent. of a grain of solid matter in a gallon, with the exception of a small per cent. of carbonate of lime and magnesia.

SPRINGFIELD, Mo., June 9.—The stock books of the Springfield Electric Railway and Power company have been opened for subscriptions. The capital stock of the company is limited at $50,000, of which the citizens are given a chance to subscribe for $25,000. The stock is guaranteed to pay 6 per cent. at the end of twelve months, and may be redeemed at par at that time. It is being taken rapidly.

The posts on which the electric railway company will run its wires will be made of gas pipe, and will be ornamental as well as useful. They will be arched across the street and will be placed two hundred feet apart. On such portions of the line as are not reached by the lights of the city, the company will place lights so that the entire line will be illuminated at night. The opening of the line for operation, which will be in August, will be celebrated by the company and city in grand style.

HALLSVILLE, Mo, June 9.—During a thunder-storm last week Carpenter Bros.' mill was struck by lightning, the smoke-stack being completely demolished. On the window of the office was photographed plainly "1888," with ziz zag lines between the figures. On the wall opposite hung a calendar, from which the photograph is supposed to have been taken.

INDEPENDENCE, Mo., June 9.—The Presbyterian church here has been wired for 161 incandescent electric lights. It is asserted that this is the only church in Missouri lighted by electricity. E.

Indianapolis Items.

INDIANAPOLIS, Ind., June 9.—Judge Gresham's decision in the suit of Brush Electric Manufacturing company against Owens Pixley & Company, though in effect against Fort Wayne Jenney company, was received here by mail Tuesday of this week and created considerable excitement among those interested in electric lighting, as it makes a monopoly of arc lighting impossible, whereas, if the decision had been in favor of the Brush company, several of the electric lighting companies at present in existence would have had to close out their business.

R. T. McDonald, general manager of the Fort Wayne Jenney company, who was in this city, says: "The matter hinged entirely on the differential principle at the point where the wires connect with the lamp. Our patent was granted in 1882. All we claimed was the construction and not the principle. The Brush people had a claim in the patent office in 1880, which was granted in 1885 by a new examiner after it had been repeatedly rejected. Had that claim been maintained, it would have given the Brush company the control of arc lighting. The Brush claimed that it covered the differential principle in a patent granted in 1878, but it did not claim it then. In 1880, after having left it open to public for two years the company came forward and claimed it, and in 1885 finally got it granted, but this decision sets aside that grant on the ground that it had already been dedicated to the public."

At Monday night's session of the city council, the committee on electric lighting made its report, having visited a large number of cities and seen several lights besides those of bidding companies and found many good points in all. They made no recommendation as to accepting any of the bids, but presented the following: "Your committee report that it has information which leads it to believe that lower bids than those here reported can be had from the companies above named (Brush, Thomson-Houston, and Fort Wayne Jenney), or at least from some of them, and therefore these side bids are returned to your honorable bodies without any recommendation as to which if any bid should be accepted." The report brought out considerable sharp debate. The following motion was introduced: "That all bids for electric lighting be rejected, and that the city engineer be and hereby is directed to advertise for bids, the specifications to be modified so as to give the city the first option of purchasing the entire plant at any time within three years; bids to be opened at the next regular meeting of the council." Immediately after this a motion was made to contract with the Thomson-Houston company at their bid, the member making the motion stating he had traveled considerably, and had never seen a better lighted city than Terre Haute, Ind., where the Thomson-Houston light was in use. This motion was immediately tabled. An amendment was then offered to the former motion, "That the city engineer be requested to also advertise for any other device for lighting the city by electricity, natural or manufactured gas," which was adopted, as was also the original motion. This amendment is evidently in the interest of the artificial gas company and is regarded as a victory for them.

It is stated a company stands ready to bid for lighting the streets with incandescant lamps and use the old gas lamp posts.

There is also an agent for a patent gas enricher in the city, but as it will cost in neighborhood of $75,000 for the right to use it, that probably settles it as far as this city is concerned. Upon their request the mayor has returned the $5,000 check filed by the Thomson-Houston company with their bid.

As stated in last week's letter, the Electric Street Railroad company began work on their track on Meridian street last Monday, but were stopped by the city authorities, as their charter calls for a cable line. An amendment to their franchise, changing from cable line to electric motor, was introduced at Monday night's session of the council and referred to the committee on railroads. Their work at present is at a standstill with about 500 feet of double track down. On Tuesday morning the Citizens' Street Railway company began in several places to lay track on the Electric company's right of way, claiming their franchise gave them rights to all streets and certain alleys in the city. A special meeting of the city council was called Thursday evening to take action in the case, but adjourned without doing anything. It was decided that the companies would have to settle their differences in the courts. Col. Halloway, the manager of the electric company, says: "It is our intention to build these lines if we are permitted. The money is ready and all orders promptly cashed. Some of the persons interested have electric patents."

Wabash, Indiana, was lighted by electricity to-night for the first time. M.

Iowan Indications.

DESMOINES, Ia., June 9.—The fight that has been in progress here for something like a year between the broad gauge and narrow gauge street railway companies and which it was thought a recent decision of the Iowa Supreme court had settled, continues. The narrow gauge was the first street railway company and obtained its universal and exclusive franchise in the days before cable, electric or steam dummy lines were thought of. The broad gauge came in and secured a franchise to operate an electric railway. The narrow gauge brought suit to enjoin its new rival, was defeated in the lower courts, appealed to the supreme court, and was defeated again. Then the broad gauge began work on its tracks. On whatever street it started the narrow gauge immediately began laying track for its old "hoss" railway. And thus the fight is progressing, while many are urging the city to deprive the old company of its charter and summarily bounce it from the street.

The Capital City Gas Light company has begun erecting its electric light building. The plant will be an extensive one and the company's intention is to make it one of the finest electric light plants in the west.

COUNCIL BLUFFS, Ia., June 9.—T. J. Evans of this city has returned from an extended trip east and after careful investigation has come to the conclusion to recommend the electric motor system for use on the Council Bluffs & Omaha Bridge company's line. When the bridge is opened, a motor car service will be put on, running every five minutes between Council Bluffs and Omaha.

SIOUX CITY, Ia., June 9.—The new manager of the Western Union telegraph office, J. E. Dayhoff, has arrived from Chicago. He is not only an expert telegraph operator and well experienced in the management of an office, but is also an expert electrician generally.

The Sioux City Gas Light company contemplates putting in an electric light plant. The Edison company has had a representative here, who has obtained the specifications and is preparing to bid for the plant. F.

Nebraska Notes.

OMAHA, Neb., June 9.—Mr. Pantaleoni, the electrician and manager of the Westinghouse Electric Light company, is here for the purpose of establishing an electric light plant on a large scale.

The South Omaha Electric Light company has been organized. Application has been made to the council for a franchise, and if it is granted the company stands ready to have the plant in operation in ninety days.

The Interstate Fire Alarm company has been incorporated. The capital stock is $50,000. It will engage in the manufacture of electric fire alarm apparatus. The incorporators are F. B. Johnson, A. B. Hunt, S. L. Wiley and J. H. Dumont.

The Edison Electric Light company has submitted the following proposition to the school board for lighting the high-school grounds, and it is now under consideration: Six lamps, 100 candle power each, $650; twelve lamps, each 50 candle power, $800; twelve lamps, each 100 candle power, $1,050; twenty-four lamps, each 50 candle power, $1,200. This includes dynamos and all electric appliances complete, wiring, etc. The lamps are to be suspended from painted poles and each is to have a handsome reflector.

WYMORE, Neb, June 9.—Preparations are being made by the Wymore Electric Light company to begin work on its plant at an early day. The city has granted the company a franchise.

DAVID CITY, Neb, June 9.—An electric light plant will be established here.

TECUMSEH, Neb., June 9.—The Tecumseh Electric Light company has been incorporated. The capital stock is $10,000. A. M. Applegate and others are the incorporators.

NORFOLK, Neb., June 9.—The city has granted a franchise to the Norfolk Electric Light company. Contracts are to be let at once and the plant is to be in operation by August 10th.

CENTRAL CITY, Neb., June 9.—The city council at its last meeting granted a franchise to J. R. Gordon to establish an electric light plant here, to be in operation in six months. The lights are to be of the incandescent type, and the city will take twenty five lights. The plant will cost about $10,000. G.

Colorado Cullings.

DENVER, COL., June 8.—A proposition reported to the council by the committee on electric light and gas, of the Colorado Electric company to light the city for five years, caused considerable discussion in the last session of the council. Some of the members thought five years too long a time to let the contract for. Others favored taking more time for consideration. Others were dissatisfied with the terms. But the discussion ended in the acceptance of the proposition. The terms of the company are as follows: Twenty-seven towers now in use, $86 40 per annum; bridge lights, $12.50 a month; incandescent lights, $26 per annum; the company to have the use of the 450 iron lamps belonging to the city, and to continue the 450 erected by the company.

PUEBLO, COL., June 7.—The Pueblo Gas and Electric Light company proposes to put in an incandescent electric light system this summer. The press of the city is urging the council to withhold the incandescent franchise until it has advertised that it will be granted to the highest bidder, and then let it go to the highest bidder. J.

Gulf States News.

LAREDO, Tex., June 8.—The electric light company has begun operations. Fifteen arc lights of 2,000 candle power are being furnished by the company.

CLEBURNE, Tex., June 8.—The electric light building is about completed, and a large number of the business men are having wires and fixtures for the lights placed in their stores.

ROCKWALL, Tex., June 8.—During a storm this week lightning struck the residence of W. W. Bishop, four miles south of town, the current passing down the stove-pipe, through the floor, and killing a chicken under the house. Excepting slight shocks, no one was hurt.

DALLAS, Tex., June 8.—The Dallas Electric Light company has changed hands. Seth Miller is now the manager. A new plant will be put in and $40,000 invested. The new proprietors are determined to make the plant a success.

GREENVILLE, Miss., June 8.—The old street lamps have now been supplanted by the Van Depoele electric light system of Chicago, which is proving a perfect success. Nearly all the business houses are supplied with the new light. The plant went into operation with eighty subscribers.

BIRMINGHAM, Ala., June 8.—The Southern District Telegraph company has received the apparatus for the city fire alarm service and is busy putting it in place. The entire system is expected to be in working order in thirty days. The apparatus includes twenty-five call boxes. The telephone system is the only alarm system in use at present and has proved eminently unsatisfactory. I.

From the Pacific Slope.

OAKLAND, Cal., June 5.—Robert W. Du Rose, formerly an employe of the electric light company, has brought suit against the company for $50,000 damages for a shock which rendered him insensible and resulted almost fatally. He has since been under a physician's care and is still debilitated in mind and body.

LOS ANGELES, Cal., June 3.—Work has begun on the changing of the fire alarm system in this city from an open to a closed circuit. It is expected that everything will be working satisfactorily by the first of July. The system was put in with an open circuit by the Richmond, Ind., company, two years ago.

SEATTLE, Wash. Ter., June 2.—The Seattle Street Railway company will issue $60,000 bonds for the purpose of converting the road into an electric motor line. When the new system is put in operation Pullman cars will be substituted for the cars now used. H.

THE ELECTRIC LIGHT.

The Salem, O., Fuel, Gas and Electric Company has been incorporoted with a capital of $200,000

An electric light company has been incorporated at Norfolk, Neb, with a capital of $5,000.

The city council of Columbus, Neb., has contracted with Schroeder Bros to light the streets with the arc light for the ensuing year.

The Thomson-Houston company has contracted to install a 15 light arc plant for C. E. Brown, at 4100 Cottage Grove avenue, Chicago.

A 650 light incandescent plant has been purchased of the Thomson-Houston company of Chicago for the Hotel St. Louis at Duluth, Minn.

The Crawfordsville, Ind. Gas & Electric Light company has purchased a 100 arc light plant of the Thomson-Houston company of Chicago.

The Thomson-Houston company of Chicago has sold to the Monroe, Wis., Electric Light company a 50 arc light plant and a 500 light incandescent plant.

The Thomson-Houston company of Chicago has sold a plant of seventy arc lights to the Capitol City Gas Light and Electric company of Des Moines, Ia.

The Western Electric company, of Chicago, is installing an arc-light plant to light the planing mill and lumber yard of the G. B. Lesh Manufacturing company at Warsaw, Ind.

At Richmond, Va., the electric light committee has recommended contracting with the Virginia Electric Light and Power company for lighting the streets of the entire city for $66,000 a year.

The American Electric Construction company was fortunate last week. Several of their dynamos, valued at $3,000 each stored in the Guaranty Storage warehouse, in New York, which was burned last week, were scarcely damaged.

The city council of Blue Springs, Neb., has granted the franchise for an electric light plant and a system of lights to be operated in Blue Springs to Alexander Stewart and Ora Richards. They intend to have the system completed in about six weeks.

A new table ornamentation is jelly illuminated by electric light. The dish, hidden from observation at first by a silver cover and a mass of flowers, is suddenly revealed with the light shining through the mass from the center, and the effect is electrifying.

The heirs of Thomas O. Murphy, who was killed in Utica, on May 11th, through a shock occasioned by contact with one of the Utica Equitable Gas and Electric Light company's electric light wires, have brought suit for $5,000 damages against the company.

Sir Morell Mackenzie examined the throat of the crown prince with an electric lamp. The lamp is appended at the end of what looks like a long, slender penholder, and the proportionately small battery which supplies the electricity is worn about the examining surgeon's neck.

R. A. Robinson commenced suit against the California Electric Light company and others, last week, to declare that he is the owner of 3,500 shares of stock in the defendant company, which now stand in the name of parties defendant, W. and E. Kerr. The stock is valued at $90,000.

The Brockport Electric Light company of Brockport, N. Y., has been incorporated. Its capital stock is $15,000 and its trustees for the first year are Francis H. Leonard, George D. Morgan, Merritt A. Cleveland, Horatio M. Beach, Lucius T. Underhill, Dayton S. Morgan and George C. Gordon.

At the meeting of the Cook county board in Chicago, Monday, the finance committee's recommendation was approved to settle the claim of the United States Electric Light company for $20,355, the amount of the judgment obtained against the county, and a warrant was ordered drawn for the amount.

In an article recently contributed to the *Chronicle* by Mr. Webster, an authority in American fire insurance circles, tables are given showing the ten leading causes of fires in Pennsylvania for the years 1885, 1886 and 1887. In 1885 and 1887 electricity does not appear as a cause; in 1886 it ranked sixth among the causes of fires.

The Hallett Electrical Illuminating and Power company will soon begin work on its plant to be located at the corner of Twelfth and Franklin streets, Kansas City. A building costing in the neighborhood of $75,000 will be erected by the company. All preliminary arrangements are about completed. As required by its franchise the company has filed with Comptroller Thomas a bond for $10,000 to insure the city against damages.

The woman's reformatory prison at Sherborn, Mass., is to have an electric light plant, and the contract has been awarded to Messrs. Claflin & Kimble, New England agents for the Mather Electric Company, for 320 incandescent lights, and they will begin work on the plant at once. This makes the second state institution lighted by electricity, the other being the state almshouse, Tewksbury, Mass., of 500 lights, which was also awarded to the Mather company

Among the table decorations of a famous dinner given recently in London were the following: In the center of the polished table a miniature lake was arranged, above which ferns and lilies nodded and swayed, and in which fishes of varied colors darted, the whole surrounded by tropical plants and glowing parterres of flowers. Small electric lights were arranged about the lake and in the center a fountain tossed its spray, while a colored glass ball lighted by electricity rose and fell in the crystal jet. A wealth of tropical foliage and bloom transformed the banqueting hall into a bower of beauty in which tiny colored electric lights flashed and glowed.

The jury which was investigating the cause of Lineman Murray in New York, brought in this verdict last week: We find that the death of Thomas Murray was caused by an electric shock received from an improperly insulated electric light wire operated and controlled by the Brush Electric Illuminating company while in the discharge of his duty as a lineman in the employ of said company on May 11, 1888, at 616 Broadway, N. Y. We also find from the evidence that said wire was not in use, had not been in use for about four months prior to May 11, and was permitted to remain a live wire in a dangerous condition and position. We therefore find the Brush Electric Illuminating company responsible for the death of Thomas Murray. We strongly condemn the parsimonious spirit of the electric lighting companies in maintaining a constant menace to life and property by not keeping their wires in repair with proper methods of insulation. We would recommend that the coroner immediately call the attention of the district attorney to the illegal maintenance of wires above ground in this city.

Prof. George W. Plympton of the Brooklin Polytechnic Institute in giving expert testimony in New York last week, said that there was no safe way of insulating wires overhead, because the insulation wears off. The safest way, he said, is to bury the wires in asphalt

The electric light in mills and factories means unquestionably, says the *Millers' Gazette*, a decided reduction of fire risk, although it was argued a few years ago that electricity, generated for instance by a running belt, was a new fire hazard. There is, however, a certain minimum risk in connection with the electric light which is put forth in a number of rules just issued by the Society of Telegraph Engineers and Electricians The principal danger is, of course, from overheating of the wires, caused generally by defective joints, or corroded wires, which resist the current, and cause a rise in the temperature, or a concentration of heat at the defective point. Bad joints and bad insulators are therefore to be avoided, and such work should only be done by competent men. Arc lamps should be inclosed in order to catch any flying sparks or falling glass, and above all, dynamos should not be installed in rooms where there may be inflammable material, or where the air is charged with dust.

THE ELECTRIC MOTOR.

E. P. Shaw of Newburyport will employ the Thomson-Houston system on his Salisbury Beach railroad.

The East Side Street Railway company of Brockton, Mass., has decided to use the Thomson-Houston system.

The Newark and Granville Electric Street Railway company has been incorporated at Columbus, O., with a capital of $100,000.

The Ottawa Electric Street Railway company at Ottawa, Ill., has been incorporated, with a capital stock of $100,000. The incorporators are T. J. Graus, W. E. Rowan, G. S. Eldridge, and James Briggs.

The New York board of aldermen has authorized the use of five different kinds of electric motors on Third avenue, between Twenty-fifth and Thirty-ninth streets, by the Brooklyn City Railroad company as an experiment.

The Thomson Houston company is rapidly extending its motor business. The company has recently taken a contract for building a six-mile electric road in Witchita, Kan. The road will be opened with four cars. The company will install a second electric road at Scranton, Pa., and among other roads which it will equip are those at Syracuse and Brainerd, Minn.

The Naumkeag Street Railway company has completed arrangements with the Thomson Houston company for the introduction and trial of their system of motors on the Willows Branch of the road, and it is expected that the road will be equipped and in running condition before the close of the present season. Should the system prove successful, the extension to Ipswich will probably be carried out.

The Sprague Electric Railway and Motor company have received an order from the United States government for motors for use in the service, and an installation is to be made at once on board the United States steel cruiser "Chicago" of motors to be used in the training and elevation of the guns The electrical and mechanical apparatus required for this work will have to be of the most delicate and perfect construction.

A dispatch from Grass Valley, Nev., says: It is rumored authoritatively that a company is about to build electric works on Deer creek below Nevada City. The electricity there will be generated by water power, of which there is an abundant supply, and will be conducted to such mines in Grass Valley and around Nevada City as are not within reach of water-power. This electrically transmitted power is next in cheapness to water power itself. Several mining companies agree to take the power.

The Rochester City and Brighton Street Railway company, of Rochester, N. Y., is considering the advisability of introducing electric motors on its lines. C. B. Woodworth, secretary of the company, recently said that he was watching the progress of electrical experiments on street-car lines, and when the practicability of the motor from an economical standpoint was demonstrated he would favor its introduction in Rochester, The claims of Prof. Main have been especially considered. The inventor claims that his storage battery system possesses many advantages. He asserts that the electrical appliances, according to his method, are much more economical, and that their weight is much less than those of other systems. The officers of the street-car company say that no experiments will be made on the Rochester line until thorough tests have been made.

A dispatch from Aberdeen, D. T., says: Great excitement was caused here June 8th, by the efforts of citizens to prevent men and teams employed by the electric motor company from further plowing up the main streets for the construction of an electric motor line. Drays were driven across the street to stop the teams. A great crowd gathered and cheered the citizens upon the drays. The city marshal ordered the drays away, but the citizens returned to the attack with an order from the mayor prohibiting further work. The franchise was granted in April, 1887, with provisions requiring the consent of the property owners along the line These were not secured, and the city claims that the right under the charter expired June 6th, no consent having been secured. The company claims that the provisions of the city charter apply only to horse car lines and not to the motor line. The citizens are excited, injunctions are being prepared, and a lively fight over the franchise is anticipated. It is thought that the mayor's order will be ignored and that work will be resumed. This opposition arises from the belief the company are simply protecting their rights, and will not construct the line this year. This the motor people deny.

There are now about $6,000,000 invested in the manufacture of electric motors in the United States, and this large investment has nearly all been made within the last three or four years. It represents either the independent investment of companies engaged in the exclusive manufacture of motors, or an increase in the capitalization of companies that manufacture electric light appliances, and find the construction of electric motors a good auxiliary industry. Some of these companies employ many hundred men, sometimes approaching a thousand, and they turn out motors almost innumerable each year. These motors are of all sizes, from one-half horse power, for driving sewing-machines and such other light work, up to several hundred horse power, for heavy work. They are becoming a driving force in almost every industry, and can be utilized in localities where the cost of obtaining fuel would almost equal their operating expenses. The chief secret of the rapid advance of this new mechanical agent is found in the flexibility of its resources. Electricity is not the generator of power, but only the agency for its transmission and distribution, as it is an agent for the transmission of the human voice over the telephone wire. Through its resources power can be distributed to any point and in quantities to suit the customer. Steam, water, air, caloric, or any known agency for generating power, is either stationary or it demands stationary appliances; but electricity is its messenger boy, its Puck, who will consent to do its errands invisibly, and never ask a day off or the grant of liberty. Does a lady want an infinitesimal bit of electrical energy to relieve her boot on the treadle of her sewing-machine? It can be delivered in her room through an iron box not much bigger than her reticule. Is the restaurant keeper plagued by an invasion of flies that expel all but the most hungry and least profitable customers? They can be gently wafted to the door by a multitude of revolving fans and congéd out either into the bright sunlight or the refreshing shower. Every where, anywhere, without a particle of dust, offensive odor, or disagreeable noise, the electric motor can be set to work, and, while it will bring the substance of the thing wanted, it will leave behind everything that can give offense. The electric motor has passed its experimental stages, and the day seems to be rapidly approaching when every house will find something for it to do in lifting burdens from floor to floor, and performing every possible labor that can be done by machinery. Manufacturers have not yet begun to construct motors ornamented with gold leaf, mother of pearl, and precious stones to rock cradles in the nurseries, but these requirements will come in time —*New York Sun.*

THE TELEPHONE.

An attempt was recently made to communicate by telephone with Marseilles from Dijon, a distance of 480 miles. The experiment was entirely successful. A further trial to extend the communication to Troyes, a distance of some 600 miles from Marseilles, was but partially successful, owing, it is said, to defects in the line from Marseilles to Troyes. As soon as these defects have been remedied the trial will be repeated.

The water-jet telephone transmitter has been recently exhibited in England, where it has attracted attention, both by its novelty and its excellent performance as a long distance transmitter. G. W. de Tunzeemann said of it in a recent lecture: "The jet-transmitter consists of a small jet of water, acidulated to render it a conductor, falling upon two electrodes, consisting respectively of a platinum wire, and a platinum ring, concentric with the wire, and separated from it by a ring of glass or ebonite. The connection between the electrodes is formed by the nappe of the jet; and, when the jet is thrown into vibration by the sound of the voice, the variation of resistance between the electrodes causes it to act as a transmitter of great delicacy. This delicacy is so great that the voice of a person speaking in an ordinary tone at a distance of fifteen or twenty feet from the instrument is reproduced in a distant telephone with the most perfect distinctness."

THE TELEGRAPH.

The Ohio River railroad's telegraph office, paint shops, and master mechanic's office in Parkersburg, W. Va., were fired by lightning recently and burned with the contents.

The United States senate bill to authorize the Paris, Choctaw and Little Rock Railway company to construct and operate a railway, telegraph and telephone line through the Indian Territory has been passed.

A Maine telegraph messenger took a telegram the other day to an old gentleman 70 years old, who never had seen such a thing before, says the Lewiston *Journal*. The first thing he did was to read the printed regulations on the top of the blank, and it took him five minutes to get to the message.

The question whether mental anguish can be considered as an element of damage in an action for breach of contract, was considered in a case recently decided by the Supreme court of Kansas in a suit against the Western Union Telegraph company. The action was brought to recover damages for a failure to deliver a telegraphic message announcing the death of the plaintiff's brother; and the plaintiff contended that in assessing the damages the jury should take into consideration the mental suffering which was occasioned by the delay on the part of the telegraph company. The court, however, held that damages for mental suffering could be recovered only where such suffering was an element of physical pain or a necessary consequence of physical pain, or the natural and proximate result of a physical injury, and stated the general rule to be that "no damages can be recovered for a shock and injury to the feelings and sensibilities, or for mental distress and anguish caused by a breach of contract except a marriage contract."

An operator says in the St. Louis *Globe-Democrat*: "I

saw it stated some time ago that telegraph operators play the races on tips they get from the wires. I guess that's like a good many other fairy stories about operators who are said to get pointers about transactions given them to handle a message. Some of them play the races just for the reason any other man does, because he likes it. Very few of them are in a position to get tips. Some of them at the race track or near a turf exchange have any amount of them, but they don't have the time to put up their money, or they have been bit and ain't going to rush off and back a horse because some sport telegraphs another sport it's a good thing. A man who handles messages between owners and trainers gets some valuable pointers, and I have heard of money made from tips picked up in this way. But I don't know of any operator who has made money out of it. A trainer has just as good a chance to get wrong as a bookmaker, and an operator in a position to handle racing messages gets more tips on a race than he can gauge. I've seen half a dozen conflicting dead-sure tips on a single race. Sometimes, when there is inside news on a short horse sent from the track, an operator can make a good thing, but I don't think many of them take advantage of their position. Dozens of tips come from the east every day to a man who may be playing the exchanges, and it would require more money than men in our position have to hedge."

Miscellaneous Notes.

For obtaining fixed or detachable deposits of chemically pure and very homogeneous iron, Mr. Barthol employs the following process, according to the *Revue Scientifique:* A bath of carbonate of iron is prepared with 18¾ ounces of sulphate of iron to 2½ gallons of water, and 4¾ pounds of carbonate of soda to 2½ gallons of water. To this is added 5 gallons of water acidulated with sulphuric acid, and there is thus obtained an electrolytic liquid in which, on the one hand, are immersed the objects to be covered, and, on the other, an iron or steel anode of the size of the object to be coated with pure iron.

Thomas A. Edison, the inventor, is now dividing his time between the joys of paternity and experiments upon a new electric flying machine which he has been commissioned by the Spanish government to make for war purposes. The system will be one of revolving fans, to which power is supplied by means of a wire connecting with an electric dynamo on the earth. The fans are not only to propel, but lift the air ship. Then with a properly equipped car an officer can ascend and take photographs and sketches of the enemy's position, which will give a great strategic advantage to the Spanish commander. Mr. Edison is confident that his experiments will result successfully.—*New York Tribune.*

Electric welding has now been put on a commercial basis, says the Boston *Bulletin.* A company has been formed mainly by Boston capitalists with a capital stock of half a million, which will turn out welding machines. The machines will be sold, but the company has a royalty on every weld made by their machines To make this practical a meter is set upon them all. This meter has upon it three dials resembling those on a gas meter. By its peculiar construction, it is claimed, it will not register unless a perfect weld is made. The new company is backed by considerable capital, by which it is enabled to buy up all the experimental electrical welding methods in the country. These machines will weld anything in the shape of metal. They do not require that both metals shall be of the same material, as iron has been welded to brass in the experiments tried. The machines as they are now built will weld an iron cable or a watch-spring with equal readiness.

Personal Paragraphs.

Prof. A. Graham Bell sailed for England June 2d to attend the meeting of the Royal commission for the instruction of deaf-mutes.

Schuyler S. Wheeler contributes to *Harper's Weekly* of June 9th a very clear and interesting description of the fundamental principles of the Edison perfected phonograph.

W. J. Creelman, engineer of the Woodbury Engine company of Rochester, N. Y., spent several days in Chicago last week. Business, especially in the line of sales of their new electric light engine, he reports very good.

Mrs. W. H. Potter, wife of the general manager of the Nebraska Telephone company, died in Seward, Neb., May 23d. Mr. Potter was in Chicago at the time of his wife's death. Mrs. Potter had been ill for several months, but was thought to be improving until within a short time of her death.

S. A. Duncan, superintendent of the Allegheny County Light company of Pittsburgh, Pa., was in Chicago two or three days the latter part of last and the fore part of this week. Mr. Duncan is recovering from a severe attack of pneumonia and is on his way to Colorado for a month or two vacation.

Edward E. Higgins, formerly of the Standard Electric company, has accepted a position with the Sprague company as managing agent for Western New York, with headquarters at Buffalo. Mr. Higgins' reputation for ability and energy is high, and the Sprague company is to be congratulated on acquiring his services.

A. F. Upton, treasurer and general manager of the Jarvis Engineering company, of Boston, died suddenly, June 11th, of apoplexy. The company with which Mr Upton was identified has performed important pioneer work in installing steam plants for electric-lighting companies. Mr. Upton's ability and experience were recognized throughout the country, and he formed a large nnmber of warm friends in electrical circles.

Capt. John P. Keiser, president of the Laclede Gas Light company, was recently in Chicago looking into the subject of electric lighting. Capt. Keiser has had a wide experience, especially in matters pertaining to mechanical engineering. He was one of the contractors who built the famous St. Louis bridge across the Mississippi river, and the prediction can safely be made that in the field of electric lighting the Laclede Gas Light company will have the success under Capt. Keiser's progressive and energetic management which he has achieved in other directions.

Business Mention.

The Franklin Motor company, of Detroit, Mich., is out with a new motor of very neat construction. J. C. Liggett represents the company in Chicago. The motor is sold at a very reasonable price, and undoubtedly will meet with a wide sale.

The Mason Regulator company, of 22 Central street, Boston, Mass, are manufacturers of a particularly good form of reducing valve, which is meeting favor wherever used. Circulars descriptive of their various forms can be had on application.

E. Ward Wilkins, of the firm of Partrick & Carter, of Philadelphia, was in Chicago last week. Mr Wilkins has been taking an extensive business trip. He says he has found that those who have bought the annunciators and supplies of his firm have been eminently pleased with their purchases.

The Sprague Electric Railway and Motor company reports business as excellent and constantly on the increase with very large sales of standard motors. They have closed contracts for the equipment of a railway at Steubenville, O., also the Naumkeag road at Salem, Mass., and have several others ready to be closed up.

The Mansfield Electric company, of 383 Federal street, Boston, Mass., is out with "Circular D," devoted to luminous electric goods, such as luminous push buttons, luminous keys for automatic burners, and luminous pendants for pull burners, and also patent gravity drop annunciators and burglar alarms. As the advantages of luminous buttons, keys, and pendants are decidedly apparent, it can safely be predicted that a large trade in these goods is in future for the manufacturers.

The catalogue and price list of electrical testing apparatus from department No 4 of James W. Queen & Co., 924 Chestnut street, Philadelphia, is a most interesting publication in the variety of fine testing instruments shown. Queen & Co. are large importers and manufacturers, and it is a recognized fact that if any electrical instrument made is desired it can be secured of or through them. The catalogue in question is therefore an exponent of the extent of their business, showing instruments made in different countries of Europe and in America.

The Partz Electric Battery company, formerly of 1723 Chestnut street, Philadelphia, Pa., having outgrown those quarters, have leased for a term of years the handsome three-story building at 636 Arch street, and with increased facilities propose to carry in addition to their stock of medical, motor and gravity batteries, a full line of electrical supplies which they will sell at wholesale and retail. They also manufacture a full line of motors—one-eighth, one-quarter, one-half, and one and one-half horse-power motors which they guarantee to be of the highest efficiency. By stating voltage and ampere of current used, motors will be wound that will prove fully effective in either arc, incandescent, or primary currents. Send for their catalogue, or, better yet, write stating what you require.

The Matchless Metal Polish company of Chicago, is manufacturing a polish that will be of particular service to those engaged in manufacturing or operating electrical apparatus. The polish is made in two grades, one of which is termed Tripoline, and the other Matchless Metal Polish. Dr. Willard H. Morse, of Westfield, N. J., consulting chemist, embodies the following in a certificate of analytical examination: "That tripoline consists of a coffee-colored, oily substance, which, from its composition, is calculated to thoroughly, rapidly, and powerfully clean and polish metals without injuring them or anything with which it may come in contact. It does not contain any constituent having a poisonous, corrosive, or irritant action, or an action describable as attacking the surfaces to which it may be applied; that the matchless metal polish is of the same composition as tripoline, except that it is of a finer material, a lighter color, and more calculated to clean and polish surfaces of a finer organization, or plated and soft surfaces. It has all of the essential character of tripoline, and affords a protection where applied, as well as a lasting and brilliant polish."

Electrical Patents.

Issued June 5, 1888.

383,857. Governor for Electro-Magnetic Motors. Chas. F. Brush, Cleveland, Ohio.

The invention relates to improvements in governors for electro-magnetic motors, in which an endless spring is mounted on and made to embrace the governor weights. The weights are mounted on links of the crank variety, and are pivotally connected with the commutator sleeve, with the arrangement of parts such that a limited outward movement of the weights is sufficient to rotatively advance the commutator-sections from maximum to minimum points of effectiveness, to the end that prompt action and wide range of governing capacity are attained.

Claim 1 reads: "The combination with the armature shaft and governor casing connected therewith, of a commutator sleeve loosely mounted on the armature shaft, governor weights pivotally connected with the commutator sleeves, and links pivoted at one end to the weights and at their opposite end to the governor casing."

383,863. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

Claim 3 is as follows: "The combination, with a primary apron, of a secondary apron made to operate transversely to the primary apron, a magnetized plate secured in proximity to said secondary ap on, so as to draw the iron particles to said secondary apron, and means for adjusting the magnetized plate in relation to the secondary apron."

383,891. Cut-Out for Incandescent Lamps. Hermann Lemp and Merle J. Wightman, Hartford, Conn.

383,899. Electro-Therapeutic Battery. Edward J. Murphy and John Floyd, Lynchburg, Va.

383,901. Electric Power Controller. Gustave S. Neu, New York, N. Y.

383,913. Rheostat. E. Wilbur Rice, jr., Lynn, Mass.

Claim 2 is as follows: "In an electric resistance frame, the combination of a series of conducting pins or studs projecting inwardly from a suitably supported plate, a second set of pins arranged parallel with the first, but insulated therefrom, a continuous resistance strip or wire strung upon the two sets of studs and bridging the space between the two sets, and a series of switch contacts cast in one piece with the conducting pins and arranged upon the outer face of the support."

383,918. Magnetic Separator. Michael H. Smith, Halifax, County of York, England.

383,919, Insulated Wire. Henry Splitdorf, New York, N. Y.

The object of the invention is to provide a wire for electrical purposes with a non-combustible insulation.

The claim reads: "A wire for electrical and other purposes covered with asbestos fibers applied in the form of an untwisted spread and flattened thread."

383,933. Switch or Cut-Out for Electric Circuits. Jas. J. Wood, Brooklyn, N. Y.

383,941. Electric Signaling Box. Walter D. Browne, Seneca Falls, N. Y.

383,946. Boiler Alarm. John J. Ghegan, Newark, N. J.

384,010. Cash Drawer. Percy G. Williams and Alfred W. Roovers, Brooklyn, N. Y

384,035. Electro Magnetic Separator. Joseph B. Hamilton, Springfield, Mass.

384,042. Lightning Arrester. Pierre O. Keilholtz, Baltimore, Md.

384,044 Rheostat. Walter H. Knight, New York, N.Y.

The first and last claims are given: "1. In an artificial electric resistance, the combination, with a series of plates in superficial contact of a contact device and extensions on certain plates of the series with which the contact device is adapted to connect."

"10. An artificial resistance consisting of a series of metallic plates in superficial contact and a box or frame having a non-conducting and non-combustible lining."

384,077. Dynamo-Electric Machine or Motor. Andrew L. Riker, New York, N. Y.

384,088. Electric Annunciator. Charles E. Scribner, Chicago, Ill.

The object of the invention is to provide for giving two different signals, the particular signal given depending upon the current which is sent through the electro-magnet of the annunciator. Current in one direction will throw down only one of the shutters, while current sent in reversals will cause both shutters to fall.

Claim 1 is as follows: "The combination, in an electric annunciator, of two shutters, an electro-magnet with its poles extended, two armatures, one of said armatures being polarized and centrally pivoted and the other armature being neutral, the said armatures respectively engaging with the said shutters."

384,116. Electric Shunting Device. William Baxter, jr., Baltimore County.

384,117. Governor for Electric Motors. William Baxter, jr., Baltimore County.

384,151. Apparatus for Photographing by Artificial Light. Forrest B. Gould, Milford, Mass.

384,152. Demagnetizer. John Greaves. St. Louis, Mo

384,200. Magneto-Electric Liquid Level Indicator. John J. Ghegan, Newark, N. J.

Claims 1 and 3 are given: "In magnetic circuit controllers, for liquid level indicators, a movable permanent magnet whose motion in one direction is limited by a non-magnetic stop and in the opposite direction by an electric contact point."

"A float for magneto-electric liquid level indicators, consisting of a hollow glass ball having magnetic material on its outside."

84,201. Telephone Transmitter. Ezra T. Gilliland, Boston, Mass.

The invention relates more particularly to the construction of battery telephones or transmitters of that class which employ as the current varying medium, a mass of mobile material—such as finely divided carbon—resting upon a horizontal diaphragm; and it consists in supporting such transmitter upon a vertically swinging arm provided with means whereby as the free end of the arm is raised or lowered the telephone is so turned upon its support that in any position of said arm the diaphragm remains horizontal.

Claims 1 and 3 are given:

"The combination of a telephone transmitter, a hollow arm pivoted to said transmitter and to a fixed support and a rigid bar inclosed in said hollow arm, and pivoted at one end to said transmitter and at the other at said support.

"The combination, with a telephone containing a body of mobile material, of a vertically swinging arm upon which said telephone is mounted, and means for maintaining said telephone in a horizontal position as the arm is swung up and down."

384,212. Fire-bucket Low Water Alarm. John Nolan, Philadelphia, Pa.

384,222. Relay. John E. Watson, Louisville, Ky.

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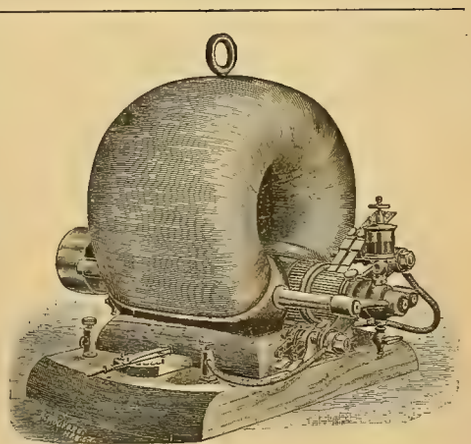

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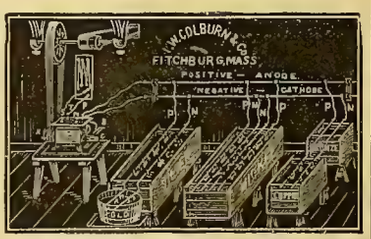

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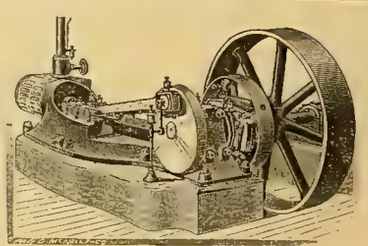

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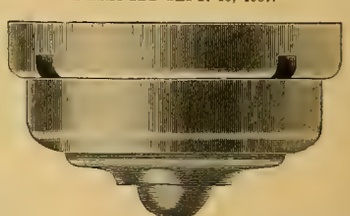

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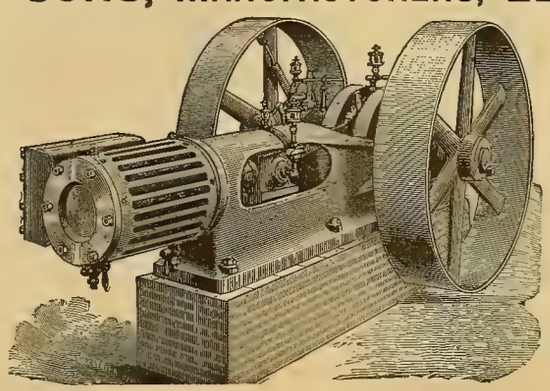

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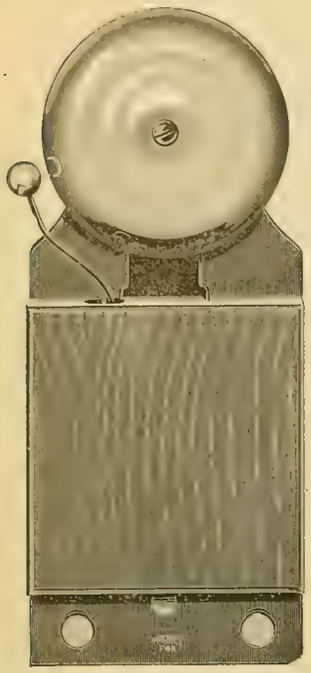

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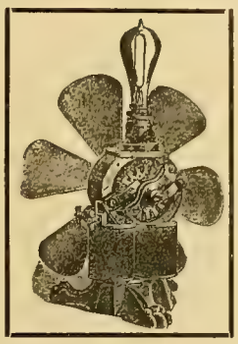

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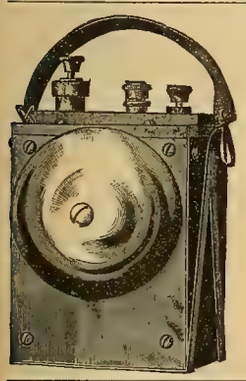

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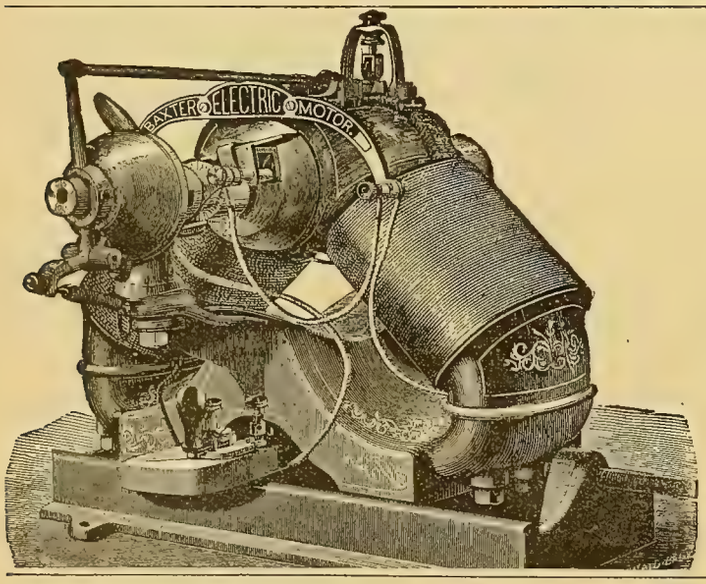

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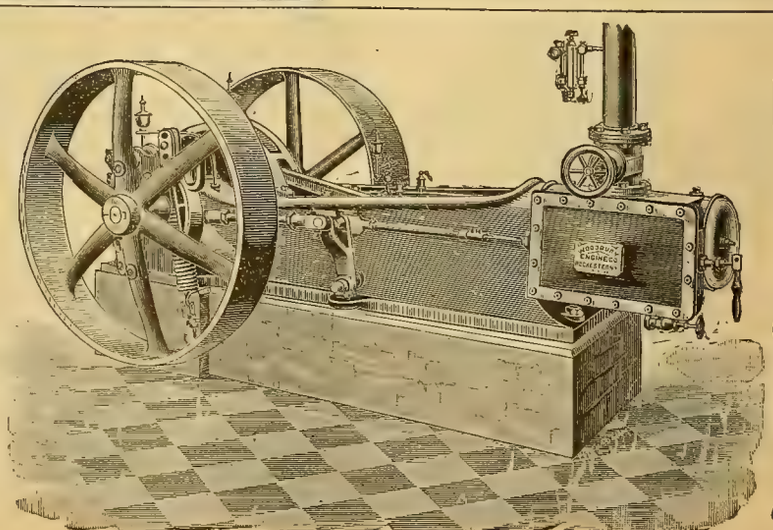

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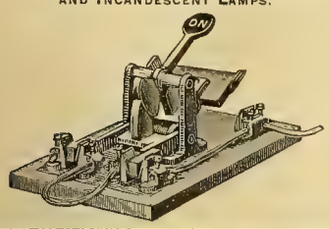

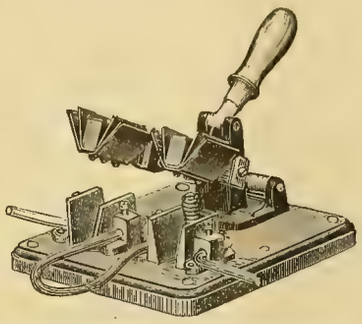

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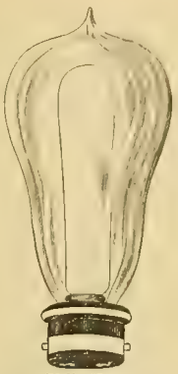

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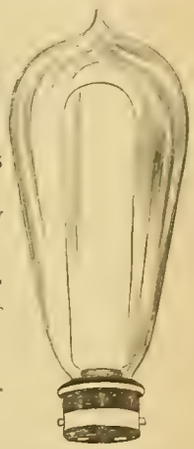

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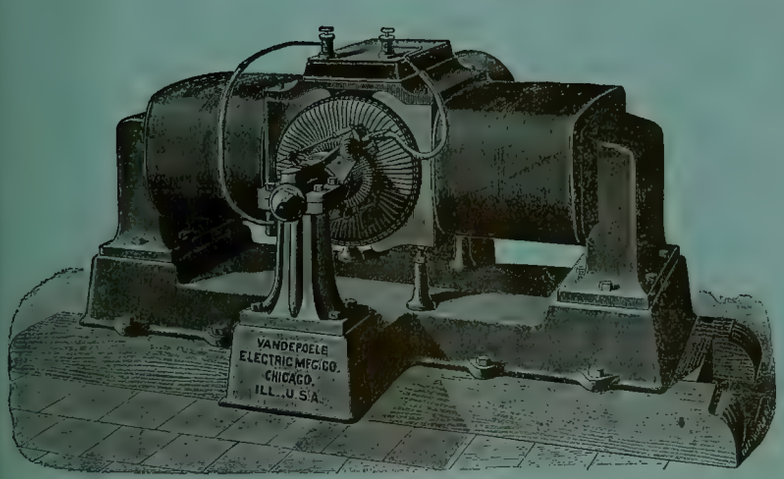

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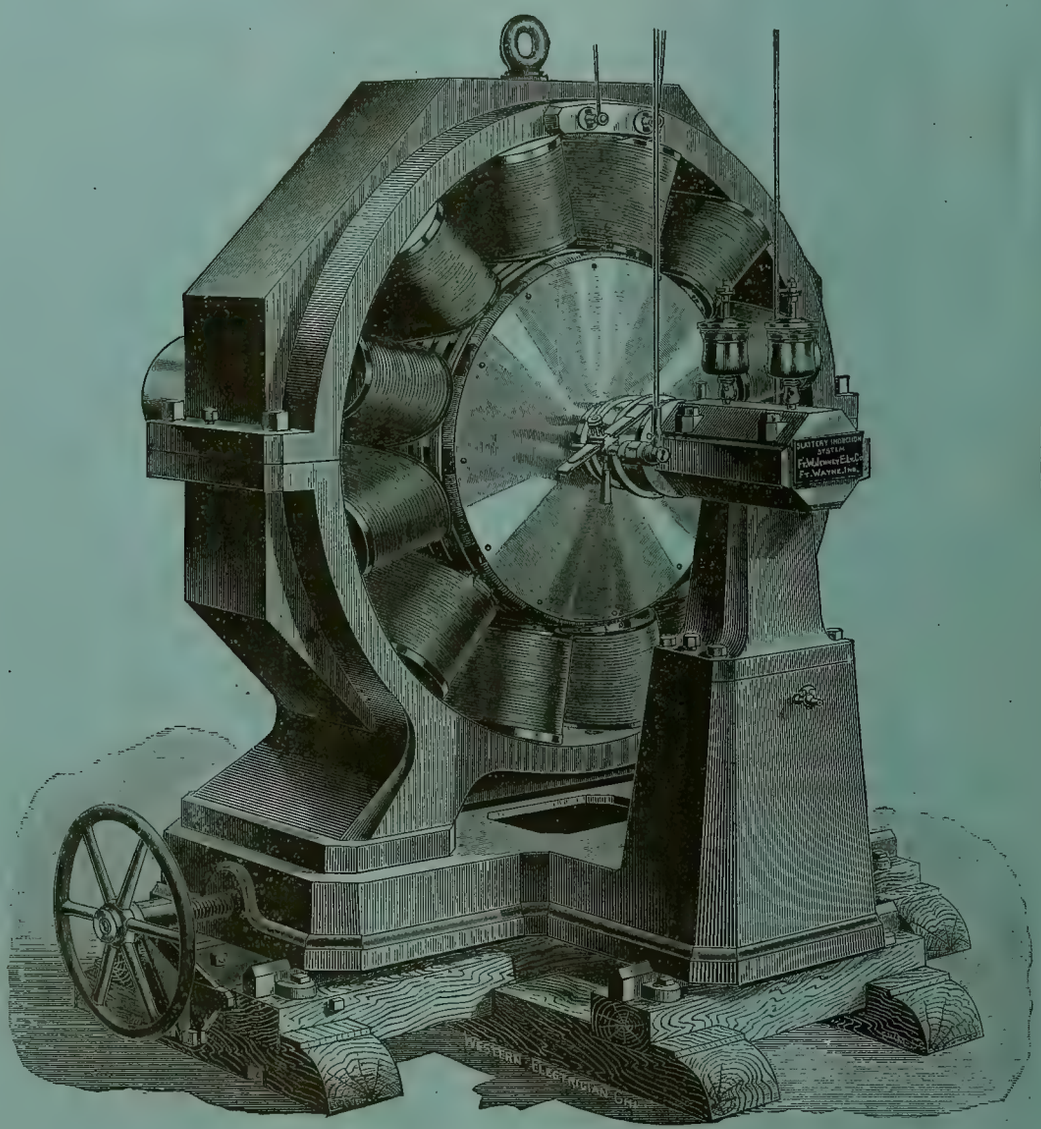

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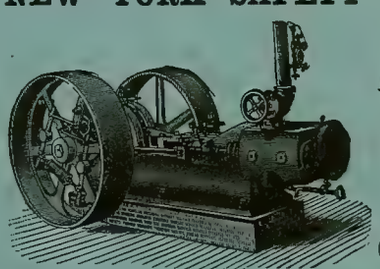

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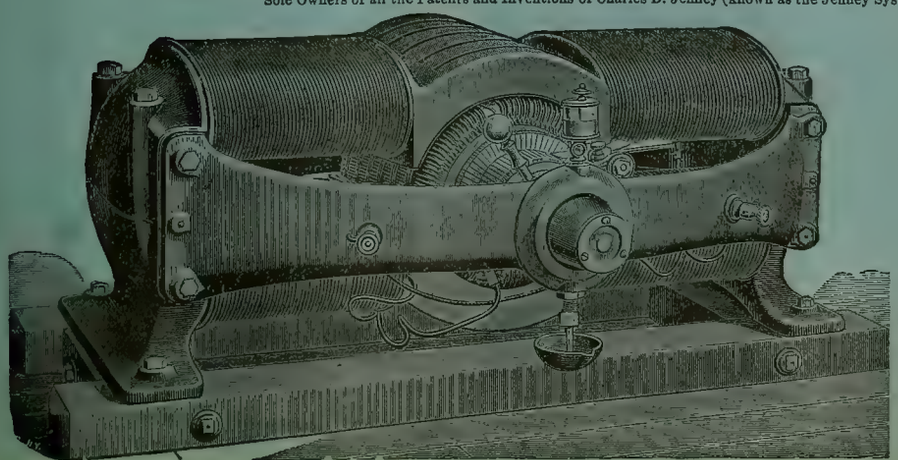

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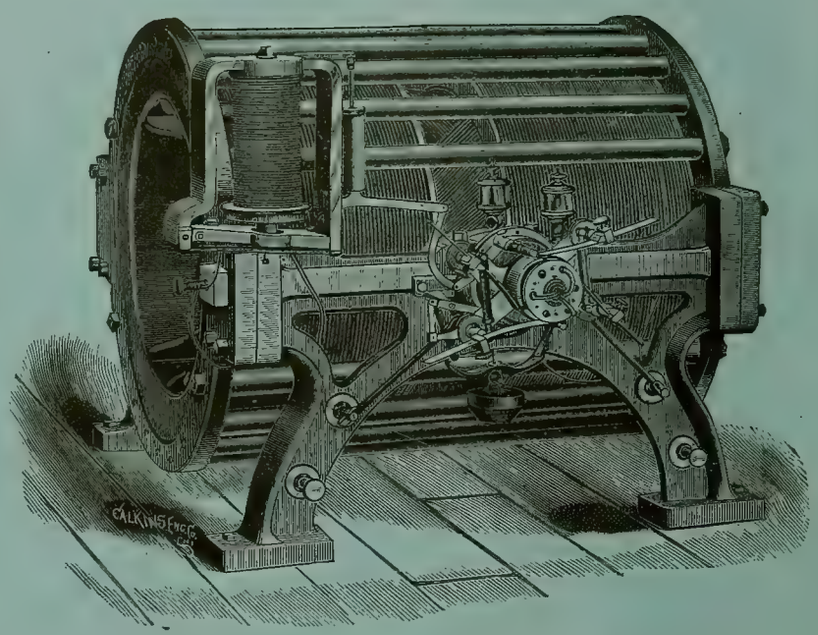

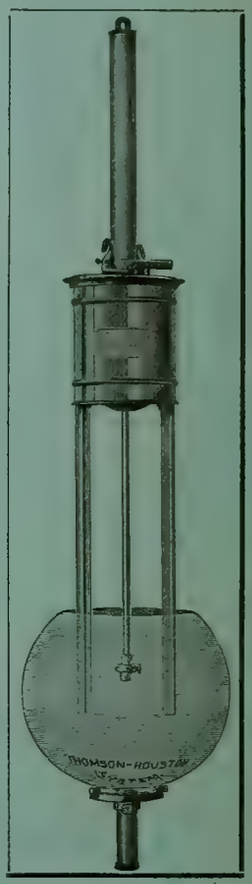

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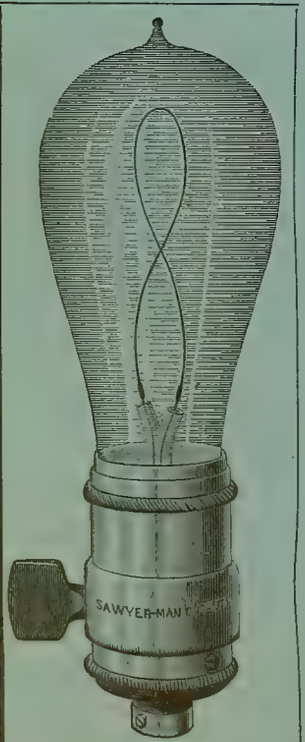

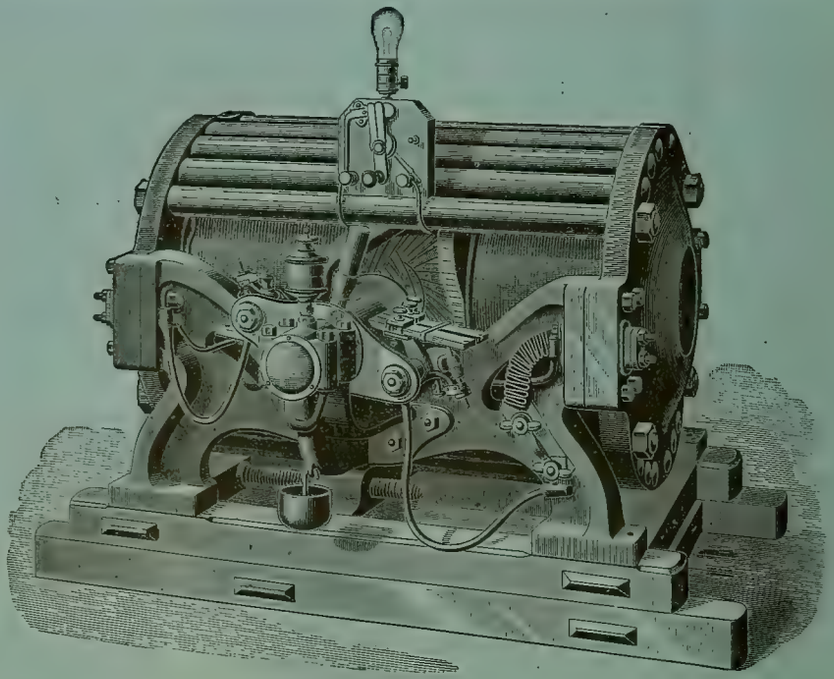

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Compensation Balance and Hair-spring,

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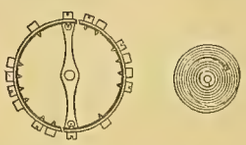

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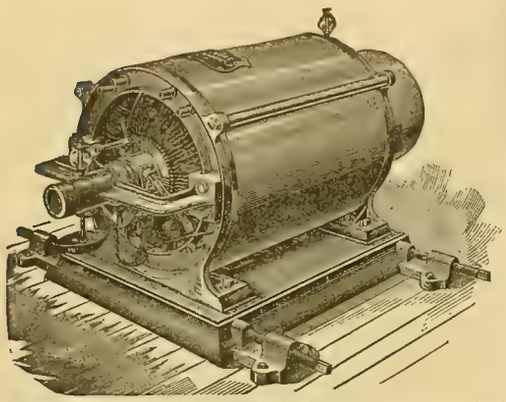

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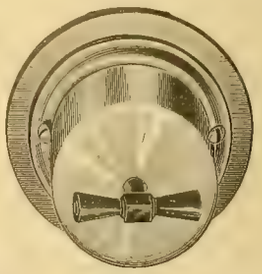
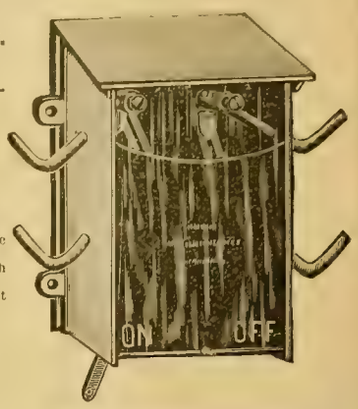
Quick Make and Break Uncontrolled by the Handle.





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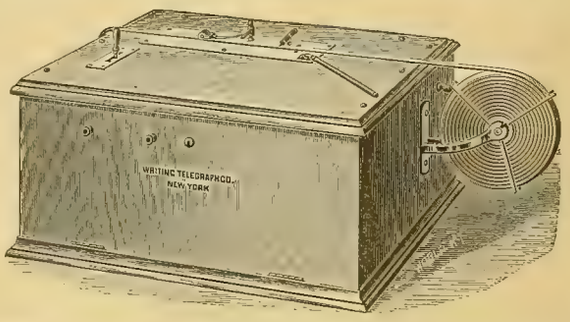

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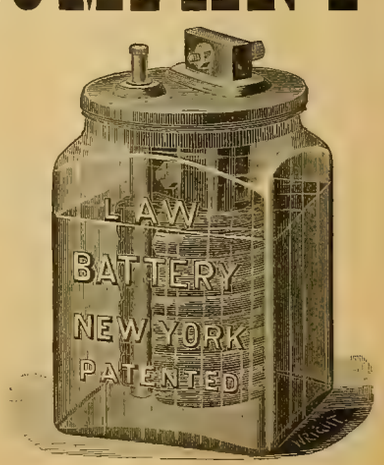

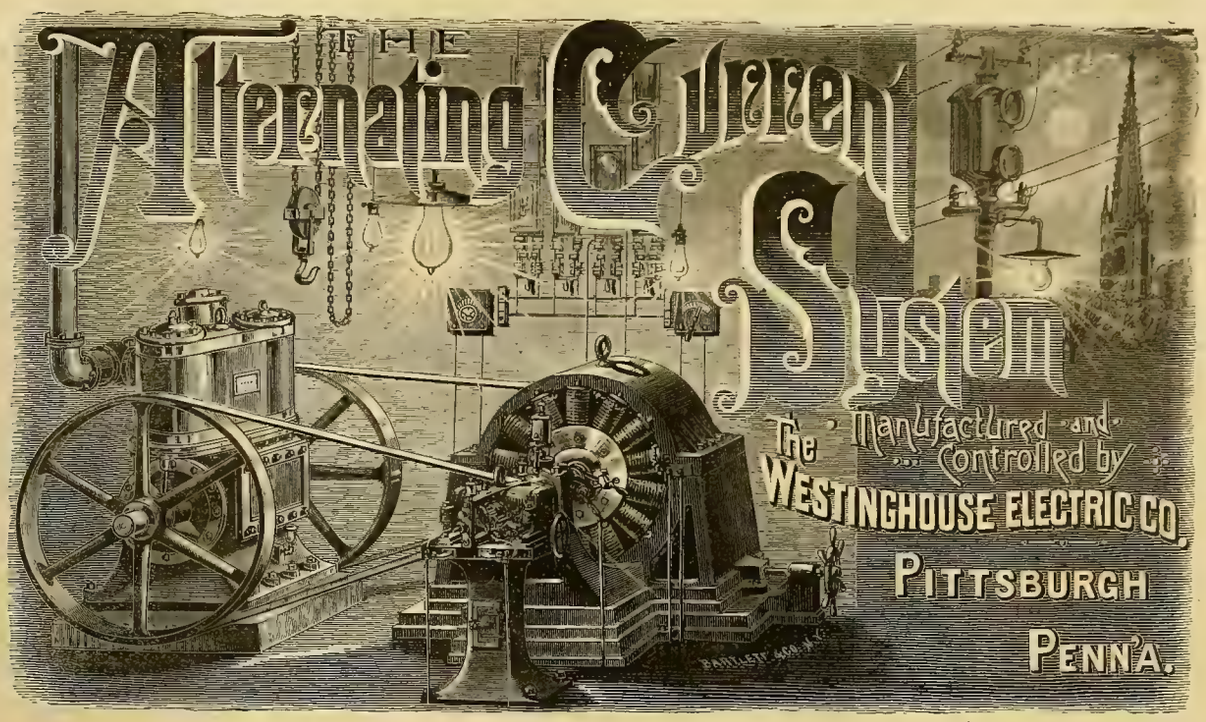

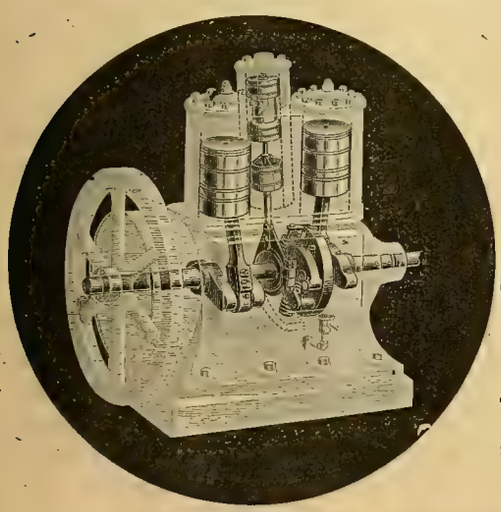

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We manufacture all kinds of Office, Annunciator and Magnet Wires and Insulated Cordage. We guarantee a conductivity of not less than 97 per cent. of the conductivity of pure copper for all our copper wire. Our largely increased facilities enable us to fill orders for goods in this line promptly and with the best quality of material.

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Over 4000 of our arc lights are in use and give satisfaction to the users. Our system of lighting is unexcelled in the perfection of its automatic regulation, the steadiness, brilliancy and color of the light produced and the efficiency of the apparatus. We furnish dynamos to give any required current. The superior efficiency of our dynamos renders them advantageous for use in charging storage batteries and for generating current for electric motors. We make Arc Lamps suited to burn on any arc light current.

Line Wire and Supplies.

We are the exclusive agents in the West of Washburn & Moen Mfg. Co.'s Galvanized Iron and Hard Drawn Copper Telegraph and Telephone Wire. The reputation of this make of wire stands deservedly high, and is a guaranty that what we furnish in this line is of the best quality. We furnish only the best material in pins, brackets and other line supplies.

Telephonic Apparatus.

We furnish licensees of the American Bell Telephone Co. with Multiple and Standard Switch-Boards, Magneto Bells and all other Telephone Apparatus.

Builders' & Repairers' Tools.

In manufacturing Bars, Clamps, Climbers, Pulleys, Splicing Clamps, Reels, Tool Belts, Body and Climber Straps, and other Tools, great pains are taken to use only the very best materials and to combine the most recent improvements.

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We manufacture a complete line of Testing Instruments, and call particular attention to the Warner Testing Battery, the Combination Bridge Rheostat and Galvanometer, and Rudd's Device for Testing Arc Light Circuits.

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Western Electrician.

EVERY SATURDAY

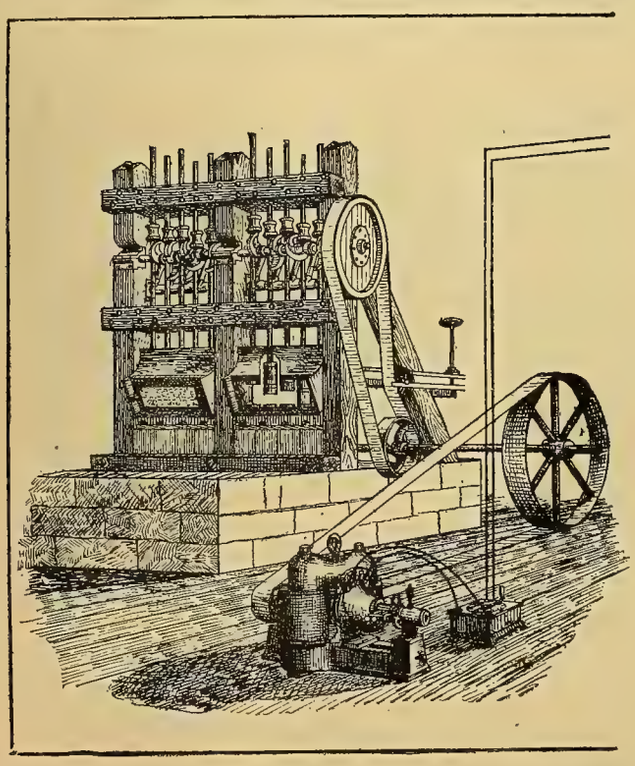
Vol. II. CHICAGO, JUNE 23, 1888. No. 25.

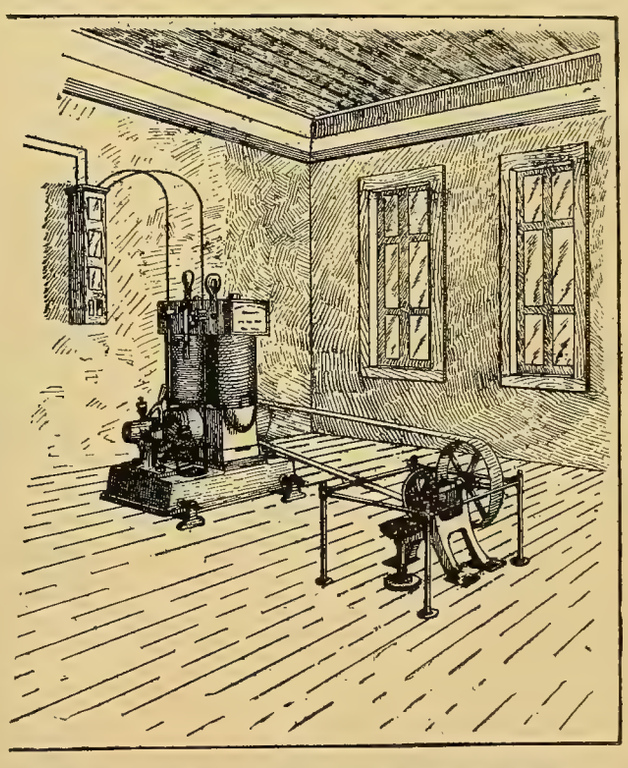
Sprague Motor Driving a Stamp-Mill.

The illustration given below shows the application of the Sprague motor for driving a stamp-mill in Idaho, situated four miles from the primal source of power. Here are five batteries of ten stamps each; the stamps have forty drops per minute and a dead lifting weight of 6,000 pounds to each battery, the total energy being 75-horse power. A transmission of this character enables the manager to locate his mill directly at the mines, and in this case gives 75 per cent. of the primal energy, besides saving $90 per day in haulage alone.

Train Dispatchers' Association of America.

The fifth annual convention of the National Train Dispatchers' association was called at the Masonic temple theater in Louisville, Ky., June 12th.





Those in attendance were: C. H. Hustin, Newton Falls; E. J. Hackenbery, Cambridge; L. N. Yelton, Rochdale, Ind.; J. E. Doud, Albany, N. Y.; G. H. Schleyer, Crawfordsville, Ind.; E. D. McKean, Ashland, O.; R. B. Woolsey, Terre Haute, Ind.; J. W. Pelot, Garrett, Ind.; J. S. Converse, Richmond, Ind.; Hugh Daly, St. Thomas, Ontario; W. F. Packard, Stanford, Ky.; E. B. Zeigler, Bucyrus, O.; J. M. Host, Columbus, O.; A. N. Dilley, Ellinwood, Pa.; F. J. Buskirk, St. Cloud, Minn.; W. S. Fulmer, Rock Island, Ill.; E. P. Van Cleaf, New York; W. W. Polk, Water Valley, Miss.; W. H. Graves, Winona, Minn.; W. C. Sutherland, Atchison, Kan.; C. M. Coomer, East Saginaw, Mich.; W. D. Minthorn, Logansport, Ind.; H. H. Libbe, St. Joseph, Mo.; F. L. Cherry, Richmond, Va.; J. A. Dearth, Galion, O.; J. H. Carlisle, Richmond, Va.; F. J. Benthall, Boston; C. L. Pasco, Bradford, Pa.; D. E. Spangler, Columbus, O.; H. O. Paul, Columbus, O.; G. M. Sanderson, Canton, O.; W. D. Sherwood, Norwalk, O.; S. N. Hurd, Huntingbury, Ind.; H. J. Irwin, Boone, Ia.; A. A. Zion, Indianapolis, Ind.; Charles C. Wamsley, Houston, Tex.; L. B. Carll, Trenton, Mo.; C. A. Batterton, Winona, Minn.; J. F. Cleffer, Paducah, Ky.; A. J. Morgenson, Paducah, Ky.; W. B. Blanton, Dubuque, Ia.; A. E. Boughner, St. Thomas, Ontario; F. E. McAlpine, Richmond, Ind.; W. S. Oakley, Cairo, Ill.; Chas. H. Reeves, Dubuque, Ia.; A. R. Baird, Logansport, Ind.; J. B. McCall, Ithaca, N. Y.; W. M. Eggleston, Louisville; E. J. Peabody, Chicago.

The president and vice-president were absent.

E. J. Peabody, of Chicago, the secretary, called the meeting to order, and read a brief report showing what the association had accomplished since its organization. According to his statements all the district associations were in arrears for dues, and not one of them was in good standing. After the secretary had finished his report W. H. Graves, of Winona, Minn., moved that a new organization be effected. This motion was carried, and A. A. Zion, of Indianapolis, was elected president, and Mr. Peabody, secretary. All those in attendance filed their applications and were admitted into the new association.

A committee on permanent organization was appointed, composed of William M. Eggleston, of Kentucky; W. H. Graves, of Minnesota; R. P. Woolsey, of Indiana; H. O. Pand, of Indiana; T. J. Benthall, of Massachusetts. E. B. Zeigler, of Ohio, and C. M. Coomer, of Michigan, were appointed an additional committee to formulate plans for the organization of a mutual benefit association.

The committee on organization made the following report:

"The officers of the association shall consist of a president, vice-president, secretary and treasurer (the latter two offices may be filled by one person) and an executive committee, consisting of seven members, including the president, vice-president and secretary.

"The following nominations are submitted: President, A. A. Zion, of Indiana; vice-president, W. H. Coffage, of Chattanooga; secretary and treasurer, E. J. Peabody, of Illinois; executive committee: C. S. Pasha, of Pennsylvania; H. H. Libbe, of Missouri; W. H. Graves, of Minnesota; W. W. Polk, of Mississippi."

The recommendation of the committee on organization was subsequently adopted.

The committee on constitution recommended that the name of the association be changed to the Train Dispatchers' Association of America. It also reported a constitution for the mutual benefit feature of the association. This latter provided, among other things, that any train dispatcher in America between twenty-one and fifty-five years of age might become a member after passing a medical examination.

The recommendation and report were adopted.

After this business was disposed of, the chair announced that W. M. Eggleston had been elected chairman of the committee on mutual benefit association by the members of that committee.

H. O. Pond, W. B. Blanton, C. A. Batterton, J. D. Doud and W. H. Stevens were appointed a committee to prepare topics for discussion at the next convention. W. H. Graves, J. W. Pelot and W. P. Sutherland were named by the chair as a committee on resolutions.

Thirty or forty names were added to the membership roll.

The association finally adjourned to meet next year in Indianapolis.

A Chicago milliner has invented a method by which all the articles in a show window can be kept in motion on a continual parade before the eyes of spectators on the sidewalk. He employs electricity as a motive power. He proposes to introduce the patent in Paris and in other large cities of Europe, it is stated.

The Victor Turbine.[1]

Several valuable improvements have been made recently in the details of the construction of the Victor wheels, manufactured by the Stilwell & Bierce Manufacturing company, of Dayton, Ohio. The cylinder is now made longer and heavier; the bridge-tree that supports the wheel has been straightened; the wood step is held in a detachable sleeve in the hub of the bridge-tree so that a new step can be put in without disturbing the wheel, and facilities are provided for setting up the step to compensate for the wear upon it; the form of step and also the step-shoe have been changed so as to secure more perfect lubrication and keep the step-shoe cool, thus preventing the burning out of the step; the form of the coupling has also been changed, affording longer jaws and greater strength; and the diameter and length of the shafts, which are made of the best hammered iron, has been increased.

In the outer chute-case the cylinder is one casting, and after receiving the bridge-tree, and chute case, which is secured by set-screws, it is placed upon a horizontal boring-mill, and the chute-case is bored out to receive the register-gate which revolves within it. The cylinder has a projecting flange which rests upon the floor of the flume, and this flange is faced off true, at a right angle with the wheel shaft, so as to insure the wheels setting plumb, provided the floor of the flume is level. The improved inside register-gate is cast in one piece, with fixed waterways, corresponding with the chutes in the outer case, the two combined forming one duplex chute. This gate is bored out to receive the wheel and is turned off to fit the outer case, within which it revolves, and it is removed, for the purpose of admitting and shutting off the water, by means of a segment and pinion. The movement of this register-gate regulates the amount of water supplied to the wheel, and receives an equal and uniform delivery on all parts of the wheel without changing the direction of the current or the relative angle of the stream and the face of the bucket, or in any degree checking the velocity of the water admited to the wheel. The hub of the four-armed spider attached to the gate is bored out to fit accurately upon the lower end of the pedestal, which projects beneath the top of the wheel case and forms a journal bearing. This patented improvement in its practical working has been found to be of great value, as it enables the gate to be fitted so closely that it cannot leak and at the same time works easily; it strengthens the gate, holds it rigidly to shape, reduces the friction in running to its minimum, and obviates the objections hitherto urged against a register gate. The projection of the pedestal underneath the top or crown plate of the wheel case, and passing through the hub of the gate spider, forms another feature of the company's late patented improvements. This top is composed of a single casting of great strength. It extends over the register gate and is fastened by set screws to the outer chute case. This arrangement protects the gate entirely from vertical pressure of the column of water and renders its movements very easy. It also greatly facilities the erection of wheels, or obtaining access to them in case of accident, as by simply removing the set screws the top becomes detached. The pinion and segment by which the gate is operated are made of gun metal and are completely housed, so that they are protected from breakage by foreign substances getting in between the teeth. The cap of this housing may be easily detached by simply removing two set screws. The pedestal which surmounts the wheel case, after being faced off twice, is fastened to top or crown plate by set screws. The

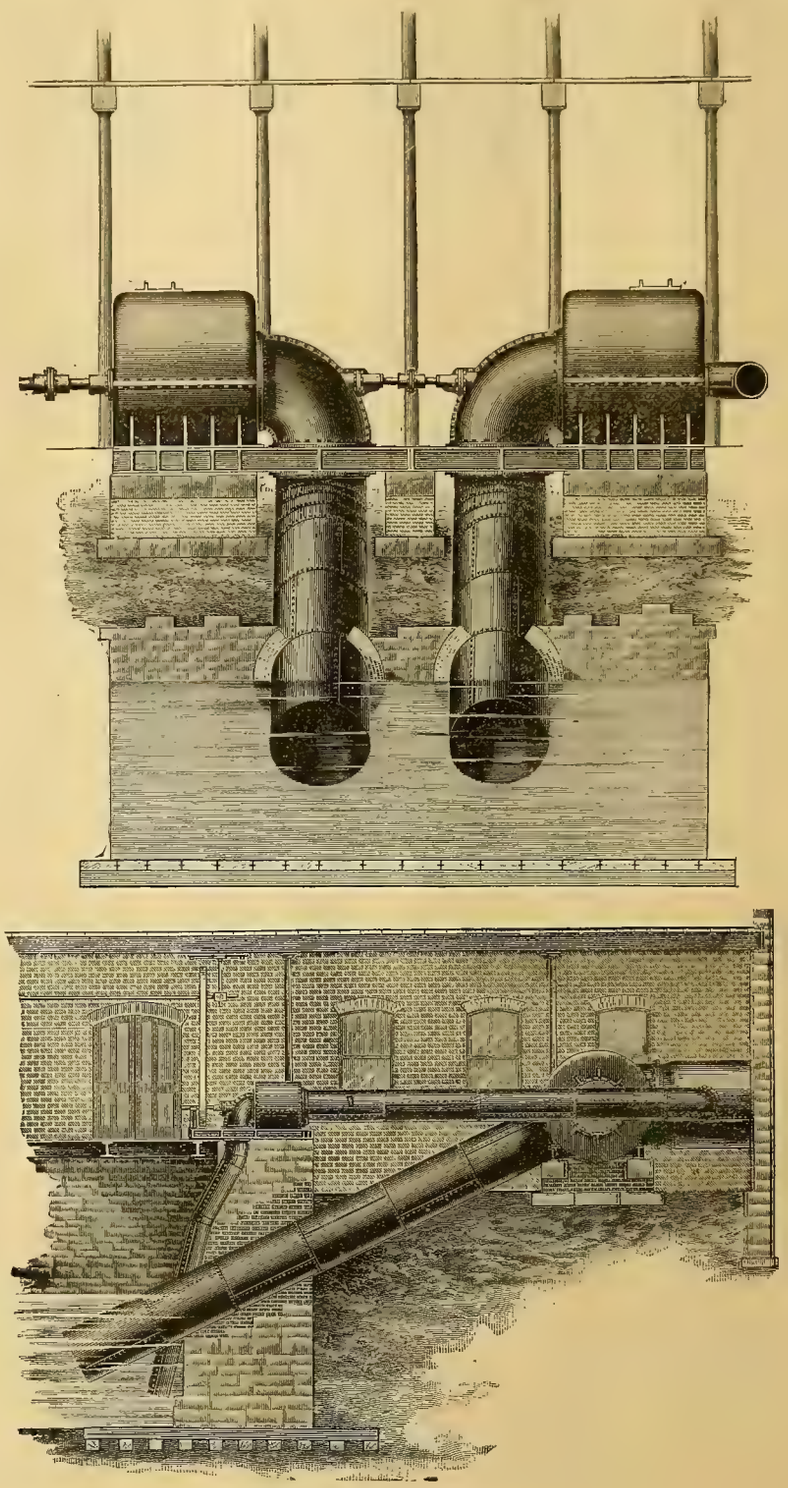


FIG. 1.—THE VICTOR TURBINE.

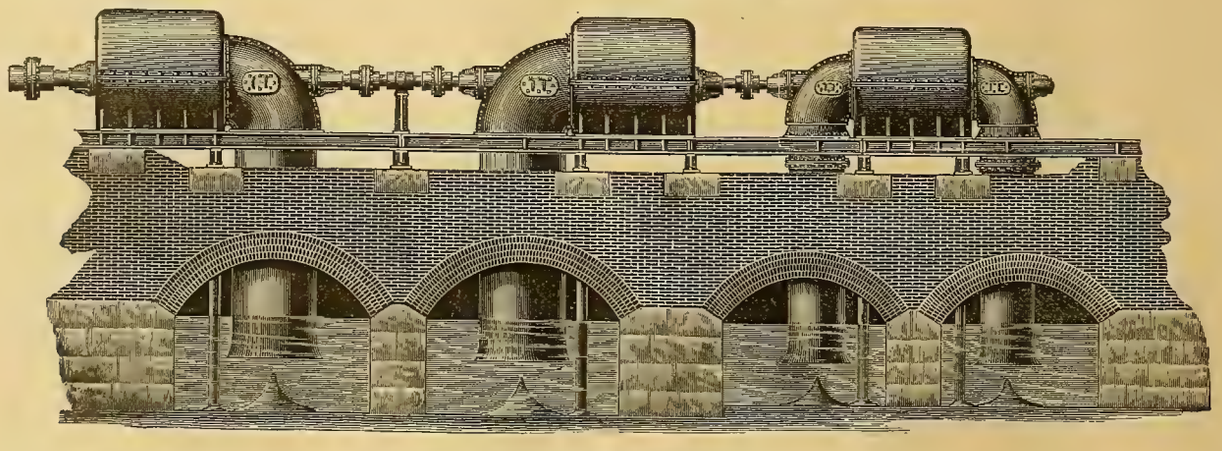


FIG. 2.—THE VICTOR TURBINE.

1 *The Milling World.*

seat below follower-blocks insures a rigid upper bearing for the wheel-shaft independent of the follower-blocks, and in connection with the arrangement of the bridge-tree, that holds the step for the wheel-shaft, it secures perfect steadiness of motion, the minimum of friction and the utmost strength and durability. An improvement in the construction of the upper portion of the pedestal that contains the follower-blocks lengthens the follower-blocks, but diminishes the height of the pedestal and admits of elevating the outer chute-case gate and crown-plate, all together, without removing the coupling from the wheel-shaft, thus exposing the face of the wheel to view by simply disconnecting the gate-rod at its coupling and removing the set-screws that fasten the chute-case to its seat in the cylinder. This arrangement facilitates the erection of large wheels in the flume and secures ready access to the wheel in case of necessity for removing obstruction.

The illustrations herewith show several different designs of the Victor turbines on horizontal shafts which have been made by the manufacturers to meet the requirements of the situation where they are placed. The turbines can be arranged singly or in pairs, and of any size and the style of flume and draft tubes and supply pipes can be made to conform to the requirements of the situation. Fig. 1 represents a plant of two 40-inch Victor turbines on horizontal shafts in independent flumes, but connected together, as shown, operating under 25-foot fall and developing 600 horse power, and one 15-inch wheel under the same fall developing 48 horse power. The wheel pit was originally prepared for a large breast wheel; this arrangement of turbines and draught-tubes located the power just where it was wanted for convenience and economy in transmission and avoided the great expense and trouble of making a new wheel pit.

Fig. 2 shows the arrangement of four Victor turbines on horizontal shaft, designed for a particular site, affording 2,000 horse power, the water being drawn from two canals at different levels, all the wheels discharging into one tail-race. The plant comprises one pair of 30-inch Victor turbines in one flume, shown at the right hand end of the engraving, to operate 26.7 feet head, developing about 400 horse power and 214 revolutions per minute, and two single 40-inch Victor turbines in iron flumes, discharging in opposite directions, operating under 48.7 feet head developing 800 horse power each, making an aggregate of 2,000 horse power, and 214 revolutions per minute. The power of the wheels is transmitted by means of pulleys and belts on an extension of the shaft, not shown in the engraving. This plan is submitted by the company as an ideal plant in point of simplicity, strength and permanency, and, with such modification as any particular site might require, it is recommended for use in cotton and woolen mills, paper mills, flour mills, electric light plants, and for any purpose where the situation will admit of it.

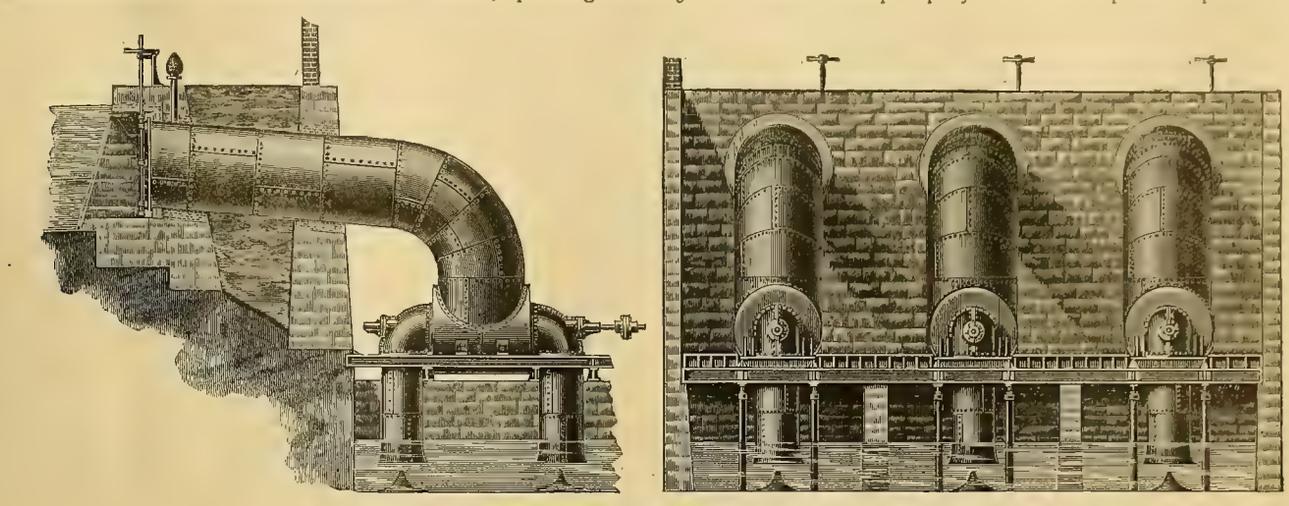


FIG. 3.—THE VICTOR TURBINE.

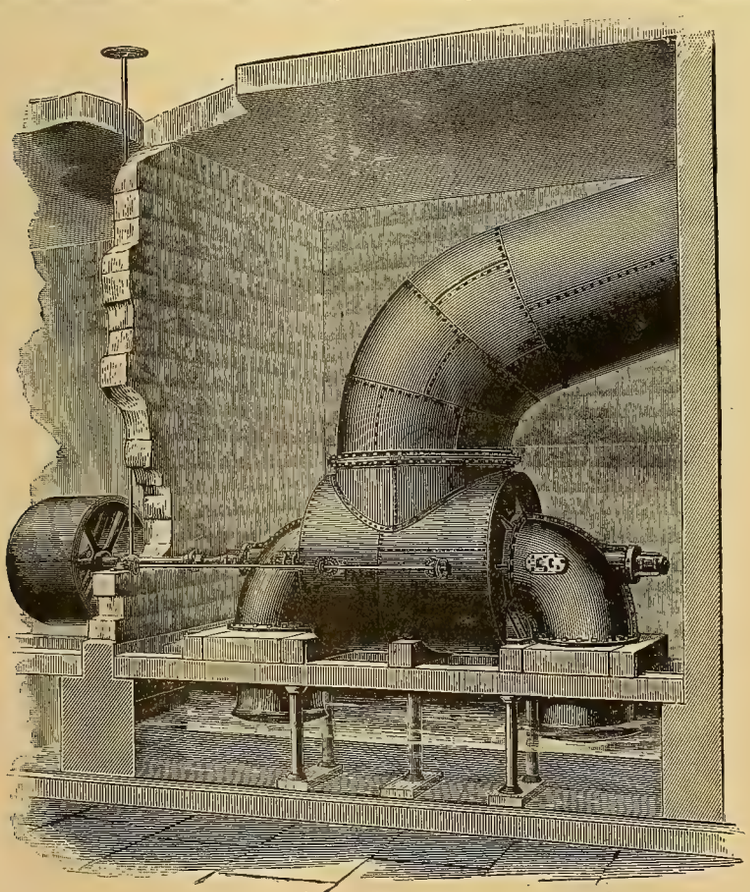
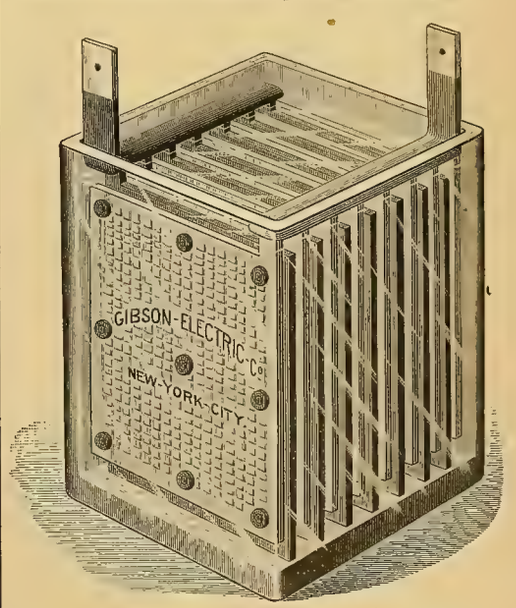


FIG. 4.—THE VICTOR TURBINE.

Fig. 3 shows three pairs of 35-inch Victor turbines, on horizontal shafts, designed for service under 40 feet head, to develop an aggregate of 3,000 horse power. Each pair of wheels develops 1,000 horse power and is placed in a separate flume, with supply pipe and draught tubes, as shown in the side elevation, so that either pair or all of them can be operated as desired.

Fig. 4 illustrates a pair of 30-inch turbines designed and erected for the Cowles Electric Smelting and Aluminum company, Lockport, N. Y. They are placed under 35 feet head, develop 528 horse power, and are used for driving the largest dynamo in the world. Since this pair of 30-inch turbines was put in an additional pair of the same design and one single turbine on horizontal shaft have been furnished the same company.



The Gibson Storage Cell.

The cut in connection shows the style of cell for a storage battery made by the Gibson Electric company of New York. In 1884 the inventor, Charles D. P. Gibson, began the manufacture of storage batteries for medical and like purposes. A broader field for the introduction of storage batteries was soon made apparent, and the inventor undertook experiments having for their prime object a reduction in weight and bulk of the cells. The cell shown is the result of the experiments. The claims for the cell are

that it has great commercial efficiency, 90 per cent. of the stored energy being available; that it is practically indestructible; that it does not require expert care for maintenance; that there is no buckling of the plates or decrease of capacity from loss of active material, and no blistering or injurious sulphating, and that rapid charge and discharge will do it no injury.

Magnetism in Watches.

BY C. K. GILES.

PART I.

I notice in a late number of the *American Jeweler* a review, by Theo. Gribi, of a paper which I read before the Chicago Electric club, entitled "Magnetism in Watches, and Its Control." [No. 24, Vol. I., WESTERN ELECTRICIAN.] I am glad that he has taken the pains to look over the paper in question, and give his views for the benefit of his fellow-watchmakers. I can assure Mr. Gribi that the Electric club paper mentioned was given entirely in the interest of science and horological perfection, and for the information of those interested and not for trade purposes, as he seems to think.

He says first, that he is "well acquainted with magnetism in watches," but I must infer from his after-language that he has only a speaking acquaintance with it, as his treatment of the subject shows that he knows but very little about it, or how it operates. He says that no such division as molecules, or atoms, can exist in matter, and are but mere "creatures of the imagination," therefore cannot be the medium for magnetic conditions. I think he hardly comprehends what he is talking about here. The molecular or atomic theory is too well established by expert scientists, and is too well proven by natural phenomena, to be upset or discarded.

FIG. 1

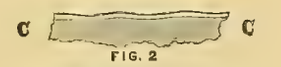


FIG. 2

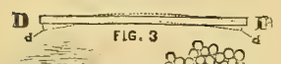


FIG. 3

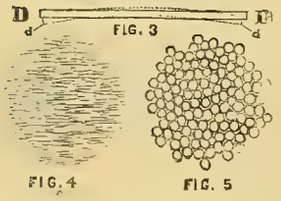


FIG. 4 FIG. 5

There are reasons to believe that, primarily, there is no such thing as matter; all matter can be translated into its constituent forces, therefore, the atom is not the ultimate, and is not necessarily infinitely divisible. The atom is where force begins to form what is generally called matter. The atom or the "molecule" is the beginning of ponderable matter,—is the first comprehensible material shape of force; but the atom, or the molecule, may not be, and is not, theoretically, infinitely small, or infinitely divisible.

Next, Mr. Gribi infers that we do not know the meaning of the expression non-magnetic, and that we have no true reason for saying "that a watch made of non-magnetic metal is an emasculated time-keeper." Now, for his information and others interested, I will give a few illustrations of physical facts and conditions connected with non-magnetic metals. By non-magnetic metals are meant all except steel. I believe that Mr. Gribi admits that all metals are primarily formed of minute crystals (molecules?). Probably the word crystals will suit him better than molecules, but it is all the same in our experiments. Now, as the metals are formed of minute crystals, then the aggregation of these crystals would make the mass of the metal, and the behavior of these molecules, or crystals, becomes a very interesting scientific study, in the treatment the metal must receive to make it ready for mechanical purposes, or to be made into a watch, also the behavior of the metal after its manufacture, and after it goes into service and is subjected to the hard usage and vicissitudes of every-day wear and tear, expansions and contractions, caused by heat and cold incident to climate. To make these conditions more clear, I have made some illustrations: Fig. 1 represents a bar of this non-magnetic metal ready for use. Without too close inspection it looks very smooth, straight and even; but the actual condition of its surface and structure is seen in Fig. 2, which represents a section of the same, magnified. It is impossible to roll out, or hammer out, a piece of metal and have it uniform on its surface, or in its formation, as every mechanic or skilled metal worker knows. Fig. 4 represents its crystals magnified greatly. Fig. 5

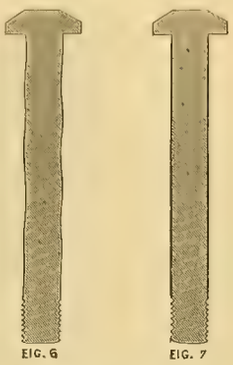
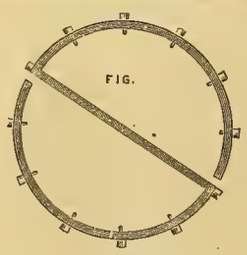


FIG. 6 FIG. 7

represents the molecules of a section of the straight piece of wire, seen in Fig. 3. We know that the effect of heat on metals is to expand the mass, but the operation is accomplished on each individual one of these little crystals or molecules seen in Fig. 5, and operates as strongly on the center ones as on the outside, and in the expansion the direction will be somewhat according to the surrounding condition, and will naturally be in the direction of the weaker, softer spots, or other uneven conditions of the mass of the molecules, and will intensify the irregularities seen in Fig. 2; then the effect would be as seen in Fig. 3, changing the general outline, and also its entire molecular arrangement. Then after the heat and expansion, and consequent displacement of molecules, follow cold and contraction; the molecule will not return to its original position, for the same reasons which have caused the irregular expansion. This expansion and contraction are being repeated continually, and the error of each preceding action is increased in the succeeding, until the bar, which at first appears straight, assumes a warped condition as seen in Figs. 2 and 3, the ends instead of being at *D*, might be as shown at *d*, and the surface irregular, as shown by the dotted lines. This irregular expansion and contraction is more definitely shown in Fig. 7, which may represent a bolt, as turned and ground very perfectly on its surface. It may be some part of a locomotive, or some fine piece of mechanism, which going into use, may become heated, and the result is seen in the warped bolt, Fig. 6. This will be recognized as practically true by those used to practical work on machinery or railways. Now, in following this metal to its place in the non-magnetic watch, we find the most vital parts, the



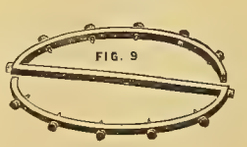


FIG. 10.

balance wheel and hair spring, subject to vicissitudes, which give the effects shown in Fig. 8, showing the balance wheel, new. Fig. 9 shows the same balance wheel after passing through many changes in temperature, which will have the same effect as seen in Fig. 3, and as a result it will be seen that the segments of the circle are warped, and the ends of the cut not opposite. By holding the balance edgewise it will present the appearance of the warped segments and arms, as seen in Fig. 10. The hair spring, Fig. 11, appears as it comes from the factory true and perfect; but after the hard usage incident to the life of the watch, the expansions and contractions of heat and cold, and being soft metal, will be liable to be bruised and bent by the tools and rough handling of the repairer, it will have the appearance of being dished, Fig. 13, the coils will be uneven, and its action must be unequal, Fig. 12. It is very evident that a watch in this condition cannot be relied upon. These same changes are taking place during expansions and contractions due to the changes in temperature from, say, zero to 100 degrees above, and must naturally throw the balance out of true and out of poise, and by frequent repetitions change the crystalline structure and elasticity of the spring, thus making a very serious change in the rate of the watch, and as explained, the error will increase with the length of time it is in use, and more rapidly during extreme fluctuations. The vicious effects on the watch of the fluctuation in temperature between 100 degrees above zero, and 20 degrees below, or 120 degrees, which is about what our railway watches have to undergo, are as trying and damaging as would be the raising of the temperature 120 degrees from the average in the pocket, say 80 degrees up to 200, and any experienced watchmaker will tell you that only the finest steel compensation balances and hair springs (made from the most carefully selected metals) will stand such a change. It is an

FIG. 11.

FIG. 12.

FIG. 13.

ascertained fact that the non-magnetic metals when lying in stock a long time become brittle and useless as springs, notably brass spring wire; the crystalline structure of all alloys will change in actual work, and through oxidation, when not in use.

The Book Table.

AMERICAN ELECTRICAL DIRECTORY. Published by the Star Iron Tower Co., Fort Wayne, Ind., 750 pp.; $2.

This directory contains reports of the proceedings of the National Electrical Light association at Detroit, August 31, 1886; at Philadelphia, February, 1887; at Boston, August 9, 1887, and Pittsburgh, February 21, 1888; an alphabetical list of officers of electric light companies; the names of manufacturers of electric light apparatus; a list of isolated arc plants; a list of isolated incandescent plants; a list of electric light companies, a schedule of the price of gas in various cities; the Philadelphia schedule for public lighting; and reports of electric light companies of the various states and territories and Dominion of Canada. For information of the character outlined it is well worth the price asked for it.

Gen. Sheridan has had eight severe attacks of "heart failure" and a number of lighter attacks. At least eight times in three weeks the general has been more like a dead man, who by superhuman effort was restored to life. Oxygen and the electric battery have stimulated the action of his heart after it had ceased to beat.

Electric Storage.

By Philip Atkinson, Ph. D.

Part I.

The accumulation or storage of electric energy is one of the most familiar facts of electric science; indeed, the construction of all electric generators depends on this principle, for since the office of an electric generator is to create and maintain a difference of electric potential, it is evident that the conditions for electric storage must exist in its construction, otherwise there could be no difference of potential. But in most generators this storage soon reaches its maximum and is accompanied by a constant electric movement from higher to lowest potential, producing the so-called current by which electric work is performed. This is notably the case in the voltaic battery. In the various kinds of static machines the storage is of longer duration, often continuing for several hours after the operation of the machine has ceased; and in the electrophorus it is practically constant. But the quantity stored in all generators is comparatively small, storage being only an accessory to the main object.

The Leyden Jar.—The first instrument specially designed for electric storage was the Leyden jar, and its discovery showed the possiblity of such storage, and laid the foundation for all subsequent experiment and discovery of this nature.

As this instrument is fully described in various electrical works, it is sufficient here to state briefly that it consists of a jar or wide-mouthed bottle, as shown in Fig. 1, composed of glass of good insulating quality, having a metallic coating, usually of tin foil, both on the inside and outside, and a broad, uncoated margin for insulation at the mouth. Through the center of the stopper is inserted a brass rod terminating below in a light chain or spring in contact with the inside coating, and above in a brass ball. When the ball is connected with any electrostatic generator, and the outer coating placed in contact with the earth, or with the opposite electrode of the generator, an electric charge, either positive or negative, may be accumulated on the inner coating, the outer coating being oppositely charged by inductions to the same degree. If now connection be made between the coatings by means means of the discharger, A, as shown, a discharge, accompanied by a flash and report will take place, showing an accumulation of electricity many times greater than the highest quantity which could be condensed in the generator by which the jar was charged. A jar, charged in this way,

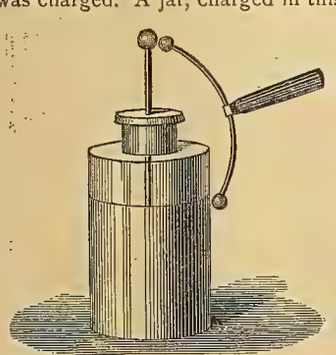


Fig. 1.

will retain a considerable portion of the charge for several hours, till it is slowly dissipated by the convection of the air. But when discharged in the manner above described, the discharge is always instantaneous, leaving only a small residuum.

The discharge of a large jar, or of several jars connected in multiple arc as a Leyden battery, gives very striking results, exploding combustibles, perforating glass or thick books, and, if the battery is large enough, melting long thick wires or destroying animal life. In its instantaneousness and its effects, it resembles the discharge of the thunder cloud; the cloud being itself a familiar example of natural storage on an immense scale.

But these various examples of storage pertain chiefly to static electricity, in which electric movement is by a sudden impulse, which usually exhausts itself and ceases, instead of furnishing a continuous current.

The Condenser.—The condenser used in connection with the electric telegraph and for other purposes is the most common example of an apparatus for storage in dynamic electricity. Its construction is on the principle of the Leyden jar, metal sheets insulated from each other by a dielectric. Fig. 2 illustrates the method of construction, the full lines representing the metal sheets and the dotted lines the insulating dielectric. Tin foil, on account of its cheapness and flexibility, is the metal best adapted for this purpose; and mica on account of its thinness, tenacity and high resistance, is preferred for insulation; but as it is rather expensive, thin paper, of high resistance, saturated with paraffine, is often substituted. As the electric charge in this case, as in that of the Leyden jar, is by induction, the intensity of which is inversely as the square of the distance, the importance of a thin dielectric of high resistance is apparent, in order that the tin foil sheets may be in close proximity,

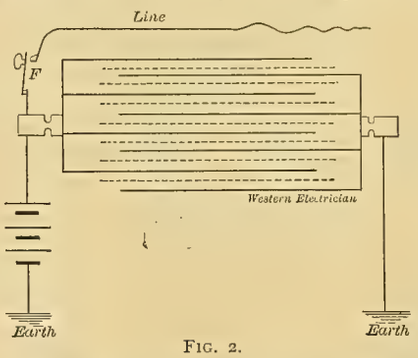


Fig. 2.

and yet well insulated from each other. The tin foil sheets are arranged in two series alternating with each other in such a manner that all the sheets of one series, beginning with the lowest, extend a certain distance to the right beyond those of the other series, which in like manner extend to the left; the dielectric extending beyond the alternate ends, and also beyond the sides sufficiently to insure perfect insulation. And all the extended ends of each series are soldered to metal strips, which brings the sheets of each series into electric connection with each other, while insulated by the dielectric from the sheets of the other series.

If the condenser be placed in the circuit of a battery in the manner shown in Fig. 2, the positive pole being connected with its left end, and the negative with the earth, and the right end of the condenser also connected with the earth, the current will flow to the upper series of tin foil sheets, and by induction, repel to the earth electricity to an equal amount from the lower series, making it negative, a flow of an equal amount of electricity from the earth to the negative pole of the battery occurring at the same time and completing the circuit, and this electric movement will continue till the condenser is fully charged. It is immaterial which pole of the battery is connected with the condenser, or with which series the connection is made, except as a matter of convenience or necessity in practical work, the charge occurring in reverse order when the negative pole is connected.

If now the upper series is placed in connection with a telegraph line by depressing the key at F, the earth and battery connections remaining intact, the charge will flow through the line from this series to the earth at the distant station, and electricity to the same amount return from the earth to the lower series, to restore the equilibrium. And as in telegraphing there is a constant manipulation of the key, there is an accompanying charge and discharge of the condenser, as the circuit is opened or closed. It will thus be seen that the condenser stores up energy during each interruption of the current which goes to the line when the circuit is closed, and thus becomes an important auxiliary to the battery. This is of course only an ideal representation of what takes place, as in actual practice the applications of the condenser are varied and numerous.

The condenser may be enlarged to any required extent by increasing the size or number of the tin foil sheets. Those connected with the Atlantic cables are of immense size, embracing many thousand square feet of tin foil.

The Adjustable Condenser.—It is often necessary to vary the capacity of the condenser to adapt it to the varied character of the required work. This is easily accomplished with the construction shown in Fig. 3, in which several condensers are so combined that one or more of them can be utilized. For this purpose all the lower series of tin foil sheets are placed in connection with a metal strip, which is connected with the thumb-screw B; a similar strip above is connected with the thumb-screw *A*, while each set of the upper series of sheets is connected with a separate metal piece placed near this strip, with an open space for insulation between. And at the points *a*, *a*, *a*, *a*, *a*, circular openings are made for the insertion of metal plugs. By the insertion of a plug at any of these openings the condenser below it is placed in the electric cricuit, and may be discontinued by its removal. And as the number and size of the sheets in each condenser may be varied to any practical extent, the amount of charged surface may, in this way, be varied as required. The numbers placed over each condenser in Fig. 3 indicate the amount of tin foil surface.

The Storage Battery.—When water is decomposed by an electric current, and the gases collected in separate receptacles, if the connection with the battery be severed, and the wires leading to the gas tubes brought into contact, a current of electricity will flow through them in the reverse order to that of the original current, the gases at the same time recombining to form water. From which it is evident that the electric energy expended in decomposing the water is stored up in the gases, and recovered when they recombine. Oxygen accumulates at the positive pole and hydrogen at the negative; and in order to collect the gases, platinum terminals for the wires are required, since the oxygen unites with the terminal if composed of any of the baser metals, and appears in the combined form of an oxide instead of the separate form of a gas. But experiment proves that electric energy is also stored up in the oxide when so formed, and may be recovered from it.

Observation of these facts by Gautherot and Ritter in the early part of the present century indicated the possibility of storing electricity so as to obtain a continued current similar to that from the battery, instead of the instantaneous discharge obtainable from the Leyden jar or the condenser. On this principle Grove, in 1842, constructed a gas battery, using at first oxygen and hydrogen collected in glass tubes with plat-

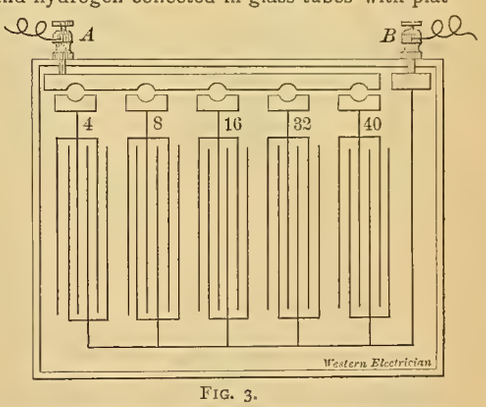


Fig. 3.

inum electrodes, but subsequently various other gases, and finally plates covered with peroxides of metals. Numerous other attempts to accomplish this were made from time to time by Wheatstone, Siemens, Kirchoff and others, but without any practical result till about 1859, when Gaston Planté, a French electrician, began a course of experiments for this purpose, which resulted in the discovery that lead plates could be so prepared, electrically, as to produce the desired result, by allowing the oxygen, as it accumulates at the positive pole, to combine with the lead of a plate provided for that purpose, and form a peroxide (PbO_2), while the hydrogen accumulates on a similar plate, at the negative pole. And on this principle he constructed his secondary cell.

(To be continued.)

The thirty-seventh meeting of the American Association for the Advancement of Science will be held at Cleveland, O., from Wednesday morning, Aug. 15, until Tuesday evening, Aug. 21.

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CORRESPONDENCE relating to electricity or any of its practical applications is cordially invited, and the cooperation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians will be thankfully received and cheerfully acknowledged.

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Notice to Subscribers.

Subscriptions to the WESTERN ELECTRICIAN, weekly, at $3 per annum and *The Electrical Engineer*, of New York, monthly, at $3 per annum now filled from this office at $5 per annum for both journals.

THOSE interested in the application of water power to electric light or power purposes, will find elsewhere some new features in regard to arrangement of turbines.

THE National Train Dispatchers' association met in Louisville, Ky., June 12th. A new organization was effected, taking the name of the Train Dispatchers' Association of America, and nearly all those in attendance signed the roll of the new association. The convention a year hence will be held in Indianapolis, Ind.

THE delegations to the national republican convention in Chicago this week endeavored to outdo each other in their efforts to decorate their headquarters in the Grand Pacific hotel. In this respect the Allison men were most successful. Over the door of their room incandescent lamps were so arranged that they formed the letters which compose the name of Iowa's favorite son. It was a novel and brilliant decoration.

THE enterprise of the Edison Electric Light company, in Boston, which recently lost its building by fire, is well worthy of remark. The fire started about 12 o'clock Saturday night and every dynamo in the station was ruined. The engines and boilers, however, were not damaged. In nineteen hours after the flames were conquered a small Edison dynamo was secured from a neighboring town and furnished current sufficient to light the station. New dynamos were telegraphed for, and by Monday night the lights were illuminating stores and residences as usual.

A STORAGE battery new to most of our readers is shown on another page. Some strong claims are made for the battery in the way of the plates being non-buckling and their freedom from injury when rapidly charged or discharged. The field for the application of storage batteries is nearly as extensive as that of the electric light or electric motor, and it is to be expected that inventors will vie with each other in this department of electrical application as well as in others which heretofore have claimed more attention. Each new achievement worthy of the name should and will be greeted by encouragement.

A TRIM little launch run by electric motors, the current being provided by a storage battery, created no small amount of comment in New York last week. A statement, credited to Frederick Reckenzaun, too, by the way, appeared in one of the New York papers that the boat in question was the first to his knowledge ever run by electricity. No man by the name of Reckenzaun would ever make such a statement after the memorable trip of the Volta across the English channel September 13, 1886. The statement might have been made that the boat was the first in America to be run by storage battery. This statement might be true, but we have no data to confirm or deny it. However, reports agree that the working of the motors was very satisfactory.

THE mining regions of the west as a field for electric motors has been a favorite text for a number of brief notes in the WESTERN ELECTRICIAN. The comparative ease with which power can be electrically transmitted to places where there is no water power or where steam power can not be used on account of the immense expense attendant upon the carriage of fuel is so strong a point in favor of the electric motor that it need not be dwelt upon. The illustration elsewhere of a motor driving a stamp mill and the brief statement of facts accompanying it, serve to mark another installation of the motor in a field in which in many cases it will have no competitor. An important statement of fact in the article in question is the saving in haulage alone, which is placed at $90 per day. This amounts for 300 working days in the year to the neat sum of $27,000, which will look very well in the dividend account of the company.

Two rather inconsistent stories concerning the mikado of Japan have recently been printed. It is related on the one hand that he has decided to restrict the privileges of Japanese journalists, inasmuch as he considers that the freedom which has been extended to them has been abused. Paragraphers delighted to poke fun at the members of the royal family, much to their annoyance. The mikado should run for office in a lively American city. His royal skin would become pachydermatous, and the harmless Japanese jokes would cease to sting. While his highness is going backward by restricting the liberty of the press, he has put himself on record as appreciating American progress sufficiently to send an engineer to America to inspect electric roads, and to report on the advisability of making similar installations in Japan. The mikado is enterprising and wise in taking this action. In no other country could he find such activity as is here manifested in the construction of electric roads. We build a dozen roads, overcome a countless number of obstacles, while the English engineers are theorizing and fighting about methods. We try all systems, and, better still, we make them all successful. By all means, let the mikado's agents inspect American roads.

THE telephone company and the city authorities in St. Lous have agreed upon a truce, and what threatened to be a war of formidable proportions has been averted, for the present at least. The cause of the trouble, as was stated last week, was the action of the local senate in passing an ordinance cutting down the telephone rates one-half. Naturally enough the company resented this interference, which it held to be illegal. Even if the action of the council was warranted by law, such a sweeping reduction could hardly be justified. The company proposed to resist and was forced to pay a fine for the violation of the ordinance. Rather than to continue its business at a loss the company began to take out telephones as contracts expired. This work was progressing rapidly when a compromise was agreed upon.

Though the settlement is merely a temporary one, the fact that the parties were reasonable enough to submit to a compromise is a matter well worthy of notice. Too often when a war of this kind is declared a reckless spirit is manifested by both parties, and neither regards the rights of the other, and the conflict is waged without advantage to either party. The subscribers are obliged to submit to the inconvenience which follows the loss of the handy telephone, and money ceases to flow into the corporation treasury.

According to the terms of the compromise the subscribers will pay at the rate of $50 per year until the validity of the ordinance is passed upon by the Supreme court. In case the decision is given in the company's favor the subscribers bind themselves to make up the amount to $100 a year. Just what the company will do in case the validity of the ordinance is affirmed is not yet clear. The prospect is, however, that the difficulty will be adjusted without a prolonged conflict, since both parties manifest an inclination to avoid acrimonious disputes. St. Louis has a splendid telephone system, and its citizens cannot afford to have it impaired.

Meanwhile the case will be watched with not a little interest in Chicago, inasmuch as it is reported that the city council will follow the example of the St. Louis aldermen, if legal authority can be found. The council will not hesitate to act if it is found that the law can be interpreted in a way to sustain the action, as no favor has ever been shown to the telephone company.

THE bill originally proposed by the National Electric Light association for the creation of a Court of Patent Appeals, has been modified to some extent, as a careful review of the amended bill, published on another page, will show. The bill as originally presented received the commendation of the National Electric Light association, and in its somewhat changed form will receive added commendation. Justice Miller of the Supreme court of the United States has this to say of the bill in a letter to George Ticknor Curtis: "It gives me pleasure to say, that, after going over the bill to establish a Court of Patent Appeals, and making a few suggestions which you accepted, I approve of the bill entirely. It will do much to relieve the over-burdened docket of our Supreme court in a direction where it can best be done. Although the bill has been submitted to no distinct vote of the members of the court, it has been considered by them all, and I feel sure that I express their concurrent opinion when I say that they all desire the passage of the bill, and will be much gratified if it shall become a law."

Justice Bradley of the same court writes: The "bill would make a great improvement in this department of judicial procedure."

The late Chief Justice Waite wrote that he agreed cordially, "especially with that which relates to the finding of facts by the Court of Patent Appeals. There is no more reason why the facts should come before us in this class of cases after trials below than there is in cases of admiralty."

Benton J. Hall, commissioner of patents, commends the bill in these words: "I am convinced that the bill meets the urgent requirements of the present situation. It will tend directly and immediately to relieve the Supreme court of its enormously overgrown docket, and to abolish the delays in the administration of law which now almost amount to a denial of justice. The patent laws in their application must be applied by expert tribunals. The patent office is an expert in the arts. It is required to be such, not only by the nature of its duties, but by the principles of its organization. It is impossible that judicial tribunals can properly and safely revise and review its work, and adjudge the rights of the public and of individuals arising from its operations, without possessing an element of the knowledge and familiarity of the expert that lies at the foundation of the whole system. I sincerely trust congress can be induced to give the subject the consideration it is worthy of."

Electric Welding.

O. K. Stewart, of the Thomson-Houston Electric Welding company of Boston, Mass., recently gave before the Boston Electric club an informal talk on electric welding, in the course of which he said :

"The history of electric welding extends over a much longer period of time than is generally supposed. Some eleven years ago, Prof. Elihu Thomson, who then held the chair of chemistry and mechanics at the Philadelphia Central High school, was delivering a course of lectures before the Franklin institute of that city, and among other experiments by which he intended to prove the substantially identical nature of electrical energy under any and all circumstances, he reversed an ordinary Ruhmkorf induction coil, showing thereby the difference of potential between the current in the primary and that in the secondary of the coil. In performing this experiment he brought the terminals of the coarse secondary winding of the coil into contact, and was surprised to notice that a high degree of temperature was reached instantaneously at the point of contact, in fact, such a high degree of heat that the ends were stuck quite firmly together, the copper wire being actually melted so that it required considerable force to separate them. Instantly the thought flashed through his brain, electric welding.

"Professor Thomson was, however, very busily engaged in teaching and lecturing, and in developing the Thomson-Houston system of electric lighting for the next five or six years, and it was not until, in the regular course of manufacturing electric lighting aparatus, it became an imperative necessity to discover some means of having more perfect joints in copper wire than could then be obtained, that his mind reverted again to the old experiment at the Franklin institute, and electric welding became an assured art.

"The theory underlying, or the principle involved in, the Thomson process of electric welding is very simple, as indeed is most of the apparatus also. The Thomson process of electric welding consists simply in forcing through the pieces of metal to be welded currents of such large volume that these pieces can carry them without heating. Now when the pieces are placed in abutment, the point of greatest resistance, as you all know, is where they contact with each other, and it is of course at this point that the heat is first generated. The instant heat is generated at the point of contact, the resistance at that place enormously increases, and a consequent more rapid development of heat is the immediate result. The metals are consequently raised to a high welding temperature in a remarkably short space of time, and upon a slight pressure being applied to force the pieces together, a perfect welding is effected.

"The field that is open for the process of electric welding is surprisingly vast, and of course no one can tell where it will lead to. I think the most important reason why electric welding is taking its place so rapidly—no, I will not say most important, but one of the most important reasons why electric welding is taking an important place so rapidly is that the heat generated by the current is the only absolutely pure heat known in the world. The blacksmith, when welding with either a gas furnace or a coal fire is constantly running the risk not only of burning his metal, but of introducing into it foreign matter in the form of gases which are very deleterious to the substances of either iron or steel, which are the principal metals worked by blacksmiths.

"Now the heat generated by the electric current is absolutely free from all foreign and harmful substances, and it is this fact I think which very largely accounts for the rapid advance of electric welding, so far as practical work is concerned. Of course, this is not the only reason. One very important reason is the fact that the heat effected by the current is under absolutely perfect control. I do not mean to say that this regulation is nearly perfect, or that it is very perfect, but I state that it is absolutely perfect, for the reason that it can be made entirely and perfectly automatic. The heat can be begun and a stop placed on the apparatus which will control the heat perfectly.

"Then again, welding by the Thomson process is a much neater and quicker operation than welding by the ordinary method of forge or furnace. I might also say in this connection, that no skilled labor is necessary to operate an electric welding apparatus. I have in my mind now one young man who came to us not knowing anything of the conditions under which different metals should be welded, and who in a very short time has become so expert in handling these machines that he can now, on the first trial, make perfect welds in any of the ordinary metals and in almost all varieties of steel including, although I say it with some reservation, even mushet steel and manganese steel."

Magnetism in Watches.[1]

BY THEO. GRIBI.

We are willing to accord Mr. Giles considerable credit for his manner of treating the subject. He has evidently given the matter much thought, has ventured on new paths which no one before him had trod, and, we think, no one after him will tread But the article, purporting, as it does, to be a paper read before the Electric club of Chicago, is plainly a shrewd argument in favor of the so-called anti magnetic shield, an invention of his, and as such is open to criticism. It is truly wonderful how Mr. Giles su ceeds, or thinks he does, in subduing the dreadful enemy, magnetism, and making of it not only an obedient servant, but a friend and ever present help in trouble; but we are afraid that this is more beautiful in theory than true in fact.

We do not intend to follow him through all his elaborate speculations on the nature of magnetism; nor are we, to confess the truth, prepared to deny anything which he has advanced that is new. Indeed, we should not care to do so were there ever so much to say against it, our interest being wholly in the facts and phenomena of magnetism in watches, with which we are well acquainted, and in the means of protecting them against it. But it may be well to observe that his theory of the nature of magnetism is wholly founded on the theory of the atomic or molecular constitution of matter, and with it will stand or fall. Now, we have no hesitancy in saying that the molecular theory of matter is a mere figure of speech, a means to assist in the attempt of making some theory as touching the nature of phenomenon comprehensible, and that it lies wholly in the domain of speculative philosophy. In fact we may, without fear of contradiction, go further and assert that it is positively unthinkable; for there is no limit in our conception for the subdivision of matter. An atom, however small, must have dimensions, and its subdivision is still thinkable until the vanishing point is reached, where matter ceases to be recognized as such and passes over into force, and where molecules are no more thinkable. But Mr. Giles' argument as touching the subject in hand, though ingenious, is deceptive. We should infer that he thinks even a non-magnetic watch would go better by putting it into a shield. If we did not see the true reason he has for using such an expression as that "a watch made of non-magnetic material is an emasculated time-keeper," we should say that he has never yet grasped the meaning of the expression, non-magnetic; nay, worse than that, that he does not fully comprehend his own statements concerning the nature and phenomenon of magnetism. According to his teaching, magnetism exists as a dual force and in a state of satisfied polarity in all matter. He considers this the normal condition of matter, and that when this normal condition of polarity is disturbed "we get the phenomena of magnetic and electric effect." But in the case of the non magnetic balance we have no such effect, *i. e.*, we have no proof of the disturbance of polarity. How does he know that it exists there? We call a balance non-magnetic because we observe none of the effects of magnetism exhibited in it, such as are manifest in balances made of substances called magnetic, and we are warranted in drawing the conclusion that its movements, when in the watch, will suffer none of the bad effects attributable to magnetism. If instead of iron filings, to illustrate the lines of force, as he calls them, around a pair of horseshoe magnets we substitute filings of brass, we observe no such arrangement of them around the poles, no lines of force. Why not?

Mr. Giles' illustration of the magnetic lines formed around the poles of a pair of magnets with a shield between them practices a little deception on the reader's mind, unless he be better informed, in that it leads him to conclude that the magnetic force does not penetrate into the interior of the shield, there being no filings within that space. This is a mistake, as may easily be proved by placing a small magnetic needle within the shield, when it will be observed to respond immediately to the effect of the magnets without. If the space on the cardboard within the shield is also covered with iron filings, they will immediately arrange themselves in curved lines from pole to pole the same as the outside ones. It is true that filings placed within the shield itself, when the poles of the magnets are in contact with it, are comparatively uninfluenced by the magnetic force, and fall about in the shield freely; but this is not owing to any anti-magnetic virtue in the shield proper, as the reader might be led to think, but to the fact that the contact of the shield with the magnets closes the magnetic field of each and leaves the space between them comparatively neutral. The same effect may be produced by using an ordinary tin movement box, or a shell of magnetic metal of any kind and shape enclosing a space. Indeed, without the use of a shield, if we close the magnetic field of the magnets by placing a piece of steel over the poles, thus connecting them, a third piece of steel laid in the space between the two magnets when in juxtaposition is neither repelled nor attracted by either. Of course we understand that Mr. Giles bases his claims of the anti-magnetic qualities of the shield upon this very fact. By surrounding the watch movement with a shield of highly magnetic metal he places it within this neutral ground, and the reader is invited to think that he thus protects it from the influence of magnetism, or if he cannot be induced to think so, he commands other resources by which he invites him to believe the realization of the still more difficult solution of the problem of making magnetism subservient as a means of more accurately regulating a watch than by any other means. We know not the possibilities which human engineering has in store in the utilization of nature's unemployed and now mischievious forces. The cyclone may yet be harnessed to the plough. But we must be excused if our conscientious scruples hold our judgment in abeyance pending the production of more solid truth. We have given this matter some serious thought, impelled by a love for the truth. We would welcome in any shape, even the "multipole balance." But we feel so badly when we are disappointed that we have become cautious in the acceptation of anything, though it may be backed by the recommendations of powerful corporations.

We have already drawn attention to the fact that this so called neutral space within the shield is not wholly neutral, that iron filings, when properly strewn inside the shield, will form into lines of force the same as those outside of it; that the compass needle, when placed within the shield, will immediately respond to the magnetic force on the approach of a magnet. If furthermore, we submerge the shield in a shallow dish of water so as to fill it half full, and then float a steel balance inside of it, it will be seen to be immediately attracted on approaching with a magnet. Yet Mr. Giles claims that "his closed magnetic circuit or shield circle remains the same and is uninfluenced." If, however, instead of a steel balance, we float a non-magnetic one, it will remain perfectly indifferent to the influence of the most powerful magnet, and that whether we float the balance inside or outside of the shield. Which of the two does the reader think would stand proof against magnetic influences in a watch?

When we see watch movements in anti magnetic shields running on the poles of magnets in show windows without stopping, we are silently asked to concede that they are not influenced by magnetism. Does Mr. Giles ever observe their daily rate, and will he tell us what it is?

Some people, other than the "the heathen Chinese, for ways that are dark and tricks that are vain," are "peculiar." They have a way of telling us one half the truth only, sometimes not even that much, and to their shame must it be said that it is generally that half which furthers self-interest only, if it does not always reflect discredit on their neighbors.!

Of this species of truth-telling is a familiar advertisement recently circulated in trade journals by a great and prosperous concern. On the one side this much respected corporation makes the statement that "most of the watches manufactured in Geneva and represented as non-magnetic, have not been such, but could be stopped by strong magnetic influences," and here it leaves them. On the next page it revindicates its own non-magnetic ware, and says that "although they can be temporarily stopped if brought into actual contact with dynamos, etc., yet their time-keeping qualitities will not be thereby affected, and when withdrawn from contact with such forces they will run as well as before. For the information of those who have not made the test," we we will here add the other half (or two-thirds?) of the truth, and state that the Geneva non-magnetic watches will not stop when laid on the most powerful dynamo, and if some of them do—for reasons well known to, but not stated by, the esteemed authors of the above advertisement,—they too, are not affected in their rate after being removed from contact with such forces. Of the same nature of truth telling, though of a much milder form, is the exhibition of watches running in shields on the poles of magnets. The fact that a watch does not stop under such conditions is no proof that its rate is not disturbed. We happen to have the liveliest conviction of this personal experience. We have made a test of four movements running in what he calls "reinforced shields," lent to us by Mr. Giles himself for that express purpose, of the result of which we have furnished him a true copy. It is not our purpose to give a detailed account of this experiment now, desiring to make some further trials ere we submit an analysis; but we may say that, while not running as badly as a watch with steel balance without a shield, they do not stand the test when running on the poles of six-inch magnets, their rate varying considerably when changing the orientation. But it is proper to state, however, that Mr. Giles never claimed to us that watches running in his shields would not suffer variations in their rate when directly exposed to the influence of magnetism, nor that they would not stop when placed on a dynamo, which they all do without exception. What he does claim is, that they are protected against the ordinary atmospheric currents (?) of magnetism to which watches are exposed when being carried. Of what moment the danger from this source really is perhaps Mr. Giles alone can inform us. He seems to think that these magnetic and electric influences are universal, and it may be so to some extent; but we would observe that it has not yet been demonstrated that watches become magnetized except when brought within the magnetic field of an electro dynamo or powerful magnet, nor that any variation in their rate, while under the ordinary wearing conditions, is due to magnetic influences, except when they have previously been magnetized. It therefore follows that, so far, this danger is only hypothetical, and it alone is that "ordinary outside magnetic condition" which Mr. Giles claims will not unbalance the lines of force in which his watch escapement vibrates. But we must really insist that the reader will commit to memory the whole paragraph in which this quotation occurs, beginning on page 30, line 2, bottom, "a watch movement placed within," etc. The boldness of the statements Mr. Giles here makes is something marvelous, and the degree to which he has succeeded in the cultivation of the imagination is exemplified in lines:

1 Abstract from *The American Jeweler*.

"And further, the vibrations of the balance wheel are controlled, to a certain extent, by the lines of inter-etheric polarity which exist in the medium within the circle, and is the steadying power or governor to rate the watch against." But the giddy height of the climax comes in the "residual force thus created" as a "tangible controllable influence." This is astonishing information of the marvels of which there is no end. We have no disposition to jest on this matter, but the thought involuntarily comes to us that what we shall hear from Mr. Giles next is that he has bottled and labeled it "patent applied for." We confess our inability to follow him, though our powers of perception do not forsake us.

It is a coarse, perhaps, but powerful argument in favor of the non-magnetic qualities of a watch when it does not stop nor show any diminution in the arcs of vibration of the balance when laid on a powerful dynamo electric machine in action, though that, as we have already said, does not prove that its rate is not effected thereby; it only furnishes a strong presumption. But we have tested this matter carefully. Along with the watches in shields we have tested also such as are claimed to be non-magnetic, subject to the same conditions. Those whose escapements are wholly made of non-magnetic materials do not show any variation in their rate, such as could be clearly attributed to the influence of magnetism, from contact with magnets, nor when changing their orientation; while such as have steel escapements do vary slightly. But we have made this further test of the latter: we have placed them on a powerful dynamo to stop them purposely, and thoroughly charge them, and then, without any change, have continued to observe their running after removing them, and we have found that the effect of stopping them did in no way alter their rate, this being just the same and as regular as before. It therefore follows that however the steel in a watch may be charged with magnetism, provided the balance, hair-spring and perhaps the table rollers, are made of non magnetic material, it does not affect the running of it. Will this be the case with a watch in an anti-magnetic shield with steel balance, etc.?

There is a les on in this which is of great value, but which we cannot follow at present, reaching as it does beyond the subject in hand. But we hope at some future time to bring it out.

Mr. Giles acquaints us with a fact which, if we have not been fully possessed of, we have long been suspicious about, and that is that a watch once magnetized can never be wholly demagnetized. This, if correct, is a powerful argument in favor of non-magnetic watches. Contrary to the pretensions which others make, as to the ease with which they can demagnetize, we are free to confess that we have great difficulty to accomplish it perfectly; some portions of the watch will remain slighly affected. Moreover, when we have thought that we had fully succeeded, the needle showing no more deflection on approach of it to the watch, there came a day when it again indicated slight affinity. We would be obliged to any one for a description of a method which they have found to give satisfactory results.

We de ire to pass one more criticism on Mr. Giles' article. On page 32, col. 1, he speaks of the steel compensation balance, which he says, "has so nearly reached perfection and which has been found to be the only compensation that will stand the test of time, and hold its shape in a wide range of temperature. Substitutes for this steel compensation balance which have been tested by both governments and individual expert horologists within the past ten years, have met with but indifferent success, and have been abandoned and rejected. Any immunity from magnetism obtained by non-magnetic material is at the sacrifice of the permanent accuracy of the watch when subjected to the wide range of temperature of our climate."

Not to question the accuracy of this statement, though we have never seen any account of such tests in spite of our endeavors to acquaint ourselves with everything of importance to our business, we would say to Mr. Giles that he his behind the times. The Paillard non-magnetic balance, though long ago on the road of experimental research, has not been put upon the market until within a year or two, at least I am not aware that any private or government tests have been made on it before, except by the inventor. As for the Palladium hair spring—a material forming the principle constituent of the Paillard balance—it has, to my certain knowledge, been in use for the past fifteen years, and the French government, if I am not mistaken, gives preference in its purchases for the navy to chronometers sprung with Palladium springs. Competitive trials, moreover, are being made annually in many of the European observatories, notably in Geneva, Neuchatel and Kew, in which both the Palladium balance and hair springs exhibit as close results or better ones than the steel balance and spring. That the non-magnetic balance of Paillard is adjustable to heat and cold we have the most positive proof in our own experience. That its adjustments will remain unimpaired after years of service nobody has, as yet, any reason to doubt. Besides, the steel compensation balances found in the ordinary run of watches are not so constant in their adjustments as Mr. Giles would have us believe.

The adjustability of a compensation balance is based upon the difference of expansability of two metals of which it is composed. That being secured there is no reason except in the quality of the work why it should not remain reasonably constant unless it can be shown that the expansability of metals varies in time. This, however, we have as yet never seen asserted. In the attempt to cast a doubt on the permanency of the adjustments of the non-magnetic compensation balance, it seems to us Mr. Giles resorts to pleading as a last resource. He is in effect begging the question. But this we cannot grant him, however kindly we feel disposed towards him. The points that we have endeavored to make are: That the so-called "anti-magnetic shield" is a protection against a hypothetical danger only; that the moment a watch in such a shield is exposed to known magnetic influences, as when brought within the magnetic field of even a six-inch magnet, its rate varies and becomes wholly unreliable; that the anti-magnetic shield does not prevent a watch from stopping when brought within the magnetic field of an electro-dynamo, and becoming permanently magnetized and unfit for use.

On the other hand: That the so-called non-magnetic watches, when all the parts of the escapement are made of non-magnetic material, will not stop when brought within the field of any known magnetic influence, nor will they be affected in their rate.

These are the facts by which Mr. Giles' theory of "Magnetism in Watches" has to be tested.

A Court of Patent Appeals.

Following is the bill, as amended and revised, proposed by the National Electric Light association for the creation of a Court of Patent Appeals now pending in the House of Representatives:

A Bill to Establish a Court of Patent Appeals of the United States.

Be it enacted by the Senate and House of Representatives in Congress assembled:

Sec. 1. There shall be a Court of Patent Appeals of the United States, which shall consist of a chief justice and four associate justices, who shall be appointed by the President, by and with the advice and consent of the senate, and who shall hold office during good behavior. Any three of said justices shall constitute a quorum.

Sec 2. The associate justices shall take precedents according to the dates of their commission, or when the date of the commission of two or more of them is the same, according to their ages.

Sec. 3. In case of a vacancy in the office of chief justice, or of his inability to perform the duties and powers of his office, they shall devolve upon the associate justice, who is first in precedent, until such disability is removed, or another chief justice is appointed and duly qualified. This provision shall apply to every associate justice who succeeds to the office of chief justice.

Sec. 4. The justices of the Court of Patent Appeals shall receive the sum of eight thousand dollars each per annum, to be paid monthly.

Sec. 5. The Court of Patent Appeals shall have power to adpoint a clerk and a marshal for said court, and a reporter of its decisions.

Sec. 6. One or more deputies to the clerk of the Court of Patent Appeals may be appointed by the court on application of the clerk, and may be removed at the pleasure of the court. In the case of the death of the clerk, his deputy or deputies shall, unless removed, continue in office and perform the duties of the clerk in his name until a clerk is appointed and qualified; and for the default or misfeasance in office of any such deputy, whether in the life-time of the clerk or after his death, the clerk and his estate and the sureties on his official bonds shall be liable, and his executors and administrators shall have such remedy for such default or misfeasance committed after his death as the clerk would be entitled to if the same had occurred during his life-time. The fees of the clerk shall be the same as those of the clerk of the Supreme court for like services, but shall not exceed six thousand dollars per annum; the residue to be accounted for to the treasury of the United States. The salaries of the deputy clerks shall be fixed by the court in no case to exceed twenty-four hundred dollars per annum.

Sec. 7. The Marshal shall be entitled to receive a salary at the rate of two thousand dollars a year. He shall attend the court at its sessions, shall serve and execute all process and orders issuing from it, or made by the chief justice or an associate justice in pursuance of law, and shall take charge of all the property of the United States used by the court or its members. With the approval of the chief justice he may appoint assistants and messengers to attend the court, with the compensation allowed to officers of the House of Representatives of similar grade.

Sec 8. The reporter shall cause the decisions of the Court of Patent Appeals, made during his office to be printed and published within six months after they are made, and within the same time shall deliver three hundred copies of the volumes of said report to the attorney-general. And he shall, in any year when he is so directed by the court, cause to be printed and published a second volume of said decisions, of which he shall deliver in like manner and time three hundred copies.

Sec. 9. The reporter shall be entitled to receive from the treasury an annual salary of twenty-five hundred dollars, when his report of said decisions constitutes one volume, and an additional sum of fifteen hundred dollars when, by direction of the court, he causes to be printed and published in any year a second volume. But said salary and compensation respectively shall be paid only when he causes such decisions to be printed, published and delivered within the time and in the manner prescribed by law, and upon the conditions that the volumes of said report shall be sold by him to the public for a price not exceeding four dollars a volume.

Sec. 10. The three hundred copies of the reports of the Court of Patent Appeals shall be distributed by the attorney-general as follows: To the Commissioner of Patents forty copies, and the balance as provided in the section 683 of the Revised statutes for the distribution of the Supreme court reports.

Sec. 11. The Court of Patent Appeals shall hold at the seat of government one term annually commencing on the second Monday in October, and such adjourned or special term as it may find necessary for the dispatch of business.

Sec. 12. If at any session of the Court of Patent Appeals a quorum does not attend on the day appointed for holding it, the justices who do attend may adjourn the court from day to day for twenty days after said appointed time, unless there be sooner a quorum. If a quorum does not attend within said twenty days, the business of the court shall be continued over until the next appointed session; and if during a term, after a quorum has assembled, less than that number attend on any day, the justices attending may adjourn the court from day to day until there is a quorum, or may adjourn without day.

Sec. 13. The justices attending at any term when less than a quorum is present, may, within twenty days mentioned in the preceding section, make all necessary orders touching any suit, proceeding or process, depending in or returned to the court, preparatory to the hearing, trial or decision thereof.

Sec. 14. The Court of Patent Appeals of the United States shall have appellate jurisdiction in the cases hereafter specially provided for without regard to the sum in controversy.

1st. "From the courts of the United States having original jurisdiction of cases touching patents, copyrights, trade-marks and labels, in all cases involving these subjects."

2d. From the Commissioner of Patents in all cases touching the patentability of inventions, priority of invention among several claimants for patent upon the same invention, and in all cases of re-issue and the judicial practice of the Patent office, also all cases touching the registration of trade-marks or labels and the rights of conflicting claimants therefor.

Sec. 15. From and after the passage of this act, there shall be no appeal from the Circuit courts of the United States or any territorial or district court or court of the District of Columbia, in cases touching patents, trade-marks, copyrights or labels, to the Supreme court of the United States directly, but all such cases formerly appealable to the Supreme court shall be heard on appeal by the Court of Patent Appeals.

Sec. 16. There shall be a right of appeal from the Court of Patent Appeals to the Supreme court of the United States in all cases regardless of the amount in controversy; subject to the same regulations, however, as now exist with regard to appeals to the Supreme court in causes of admiralty and maritime jurisdiction, and to such further regulations as the Supreme court of the United States may make.

Sec. 17. All cases touching patents, trade-marks, copyrights or labels, now pending before the Supreme Court of the United States awaiting trial, shall be transferred to and heard by the Court of Patent Appeals.

Sec. 18. When any Judge of the Cour of Patent Appeals resigns his office after having held his commission as such at least ten years, or who has held his commission as such for not less than five years, having previously held a commission as a judge of Circuit or District court of the United States for a period sufficiently long to make up ten years' service as Judge of a United States court, and having attained the age of seventy years, he shall, during the residue of his natural life, receive the same salary which was by law payable to him at the time his resignation.

Sec. 19. Section four thousand nine hundred and eleven of the Revised Statutes shall be, and hereby is amended so as to read as follows: If such party is dissatisfied with the decision of theCommission he may appeal to the Court of Patent Appeals of the United States.

Sec. 20. Section four thousand nine hundred and twelve of the Revised Statutes shall be, and hereby is amended so as to read as follows: When an appeal is taken to the Court of Patent Appeals the appellatee shall give notice thereof to the commissioner, and file in the Patent Office, within such time as the commissioner shall appoint, his reasons of appeal, specifically set forth in writing.

Sec. 21. That section forty-nine hundred and fifteen of the Revised Statutes of the United States is hereby repealed.

Sec. 22. That section seven hundred and eighty of the Revised Statues relating to the District of Columbia is hereby repealed.

Sec. 23. All acts or parts of acts inconsistent with the provisions of this act are hereby amended so as to be consistent therewith.

Electrical Supply Company.

An interesting hour can be passed in the offices and stock rooms of the Electrical Supply company of 171 Randolph street, Chicago. Even a person who is well informed concerning the requirements of those engaged in electrical industries will be surprised at the magnitude and completeness of the stock. The offices are pleasant places to visit, for every caller receives a cordial welcome, and this fact may, to a certain extent, explain the popularity of the concern.

The offices have recently been fitted up, and Manager Terry has most elegant quarters in the rear of the first floor in which to receive visitors. The furniture is handsome. The floor, which is inlaid, is covered with rugs, and the apartment is light and airy. Here Mr. Terry drives ahead with his work and keeps three stenographers busy. The room is connected by speaking tubes with every department. A three-inch pipe stretches from one end of the store to the other. Speaking tubes are connected with it leading to each department. Mr. Terry can sit at his desk and converse in a whisper with Mr. Taylor, assistant manager, whose office is in the front of the store. Push buttons are used to signal. Mr. Taylor conducted a representative of the Western Electrician throughout the stock rooms. In the front of the store is a large show board containing samples of every supply needed by electric light companies. "We can show a gentleman that board," said Mr. Taylor, with a laugh, "and tell him he needs at least one article similar to everything shown there."

In the show cases are toy motors, Geisler tubes, testing sets, electric gas lighters, etc. Innumerable lines running around the room contain a seemingly inexhaustible supply of bells, push buttons, fine grades of wire, batteries, and odds and ends almost beyond enumeration.

In the center of the room is the cashier's office. Back

of that is a reception room tastefully fitted up and intended for the use of customers who may desire to rest, write letters, or converse about electric supplies. It is a cosy little room, quiet and convenient. Adjoining this room is the mailing department and in the rear of the store is the shipping department, in which Mr Carter reigns.

The basement of the building, which is 175 feet long, is crowded with hogsheads, boxes and barrels containing supplies of every description, and miles upon miles of insulated wire.

After making even a hurried visit to the establishment one is inclined to believe, as a gentleman in the same line of business in the east said a week ago, that no electrical supply house in the country can show a larger or better stock than the Electrical Supply company, or has better facilities for handling its business.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 16.—The appointment of Schuyler S. Wheeler as electrical expert for the board of electrical control gives the utmost satisfaction in electrical circles, where his engineering abilities are highly appreciated. Mr. Wheeler graduated from Columbia college in 1881, and has since been actively engaged in various classes of electrical work with the Jablochkoff, United States, Edison, and the C. & C. Motor companies. He is a junior member of the American Society of Civil Engineers and a member of the American Institute of Electrical Engineers, of which he has been one of the managers for two years. His zeal, activity, and good judgment have been manifest on every occasion, and he is looked upon as one who is determined to attain the highest honors in the profession, if they are to be secured by intelligent and faithful work.

At the recent meeting of the master car builders, held at Alexandria Bay, the committee on freight train brakes reported that the air brake was being brought to perfection for this class of cars, and did not need the application of electricity to make it work properly. The proceedings of the meeting were reported by R. W. Ryan, stenographer, who usually performs similar duties for the various electrical associations.

The Commercial Telegram company of this city has issued a writ of replevin against the Electric Reporting company of Philadelphia for 152 tickers used by the latter in brokers' offices. They are valued at $5,000 The Philadelphia company is virtually a branch of the Commercial Telegram company, and the rate cutting brought about by the competition with the Gold and Stock Telegraph company has been under its direction. A short time ago the Commercial company reduced its rates from $20 to $10 per month, and required the Philadelphia company to do the same. The Gold and Stock company at once met the reduction, and now the Commercial company orders the Electric company to put the rates back under a threat to take away the service if it refuses. The Electric company does not object to giving up the instruments, but will hold the Commercial company responsible for ruining its business. J. G Smith, of New York, is president of the Electric company. and J. T. Maxwell, of Philadelphia, superintendent

The Hebrew Technical institute, at 34 Stuyvesant street, opened its fourth annual exhibition this week, and was visited by about 400 persons who are interested in the work of the institution. There are 78 pupils, who take a three years' course, being admitted between the ages of 12 and 13 years. For the first two years they receive a graded course, but the last year is spent in that department for which they have shown the most aptitude. Within the last few weeks an electrical department has been added, provided with a dynamo and the usual assortment of electrical apparatus. One of the pupils—Max Mayer—has constructed a neat little motor, adapted for running a sewing machine. The boys are educated without cost to themselves or parents, and are provided with a substantial lunch every day.

The practical control of the telegraphic field by the Western Union Telegraph company has enabled it to declare a dividend of 1¼ per cent.

The Continental Conduit company was represented before the board of trade at Elizabeth, N. J., on Monday night, and an attempt made to obtain the assistance of the board in the organization of a company for the manufacture of the conduit in that city. The material of the conduit is a species of artificial stone, which may also be used for various other purposes. The application was referred to the committee on manufactures.

The subway commission appointed in Newark, N. J., last January to consider plans for placing electric wires under ground held its first meeting Tuesday evening. The commission is composed of Mayor Haynes, Aldermen Hill, Ballard, Van Steenbergh, and Marshall, and Messrs. Samuel Atwater and Henry Parsons. Mr. Parsons, who is the engineer of the Watts-Campbell company, said no satisfactory system for burying the wires had yet been devised. As Mr. Parsons was about sailing for Europe he was appointed a committee to investigate the matter there. He will be absent five months. It was also decided to ask the city council for authority to incur expense in an inquiry here in America.

The graduation exercises of the Stevens institute took place in Hoboken on Thursday evening, June 14th. During the exercises an announcement was made by Prof. Wood that President Morton had endowed the chair of engineering practice with a gift of $10,000. This is President Morton's fourth gift to the institute of a like amount. A mathematical laboratory, something new in education, has been added to the institute, and the old high school has been made into an electrical department. The graduating class numbered 39. P.

St. Louis Telephone Trouble.

ST. LOUIS, MO., June 16.—The trouble between the city authorities and the Bell Telephone company has been temporarily compromised. At a public meeting the telephone company submitted a proposition to replace all the telephones taken out and charge a rental of $50, complying with the ordinance, until the validity of the ordinance is tested before the Supreme court, a case being now on hand which would be pushed to a rapid conclusion. In the event of a decision in favor of the Bell company, the renters of telephones will pay at the former rate of $100 per year, but the company does not say what it will do in case the decision is against it.

This does not permanently settle the matter. It restores the telephones already taken out, and will keep them in until the Supreme court has passed on the legality of ordinance finally. If the court sustains the ordinance and the Bell company increases the charges to $100 there will be another mass meeting of subscribers, and an investigating committee will be appointed to find out what the service costs the company. If it is then learned positively that the cost is over $50, the ordinance will be amended to the proper price, and if the contrary is learned all the telephones used by members of the Users' association will be ordered out. The telephone company after this decision was reached of June 14th, immediately began the work of replacing the instruments.

The storm of June 15th and 16th played havoc with the wires of the telephone company. A number of the telephone wires, especially in the down-town portion of the city, became crossed with electric light wires, and the result was that many of the bells attached to the telephone kept up a steady ringing until the company's employes straightened out the disarranged wires. Several of the boxes were badly damaged in this manner. When General Manager Durant came down to his office Saturday he was informed by Chief Operator Casey that fully 500 wires were out of order, which meant that the same number of instruments were out of use. The employes of the company were put to work and before night most of the wires were repaired, and the boxes connected with them in good working order. Mr. Durant said the storm, so far as the lightning was concerned, was the worst experienced by the company for years.

Owing to the fact that all the employes of the Bell Telephone company were busily engaged Saturday repairing the damage done by the storm, the company had to suspend for the time being the work of replacing the telephones removed during the controversy. In regard to this matter, Mr. Durant said that the work would be resumed with renewed zest Monday and pushed until all the subscribers were accommodated. McD.

From Lawrence, Kas.

LAWRENCE, Kas., June 16.—A number of the eastern seats of learning have established courses of electrical study. The west is not far behind in recognizing the prominence and constantly increasing importance of electricity. A course was established in the Nebraska State University at Lincoln, Neb., last year. Now, the Kansas University located here is to have a course of electrical study. The legislature appropriated $5,000 for the purpose of apparatus and machinery, so that the work might not be seriously embarrassed at the beginning. The electrical laboratory at the state university embraces six rooms in the main building with stone piers for the delicate instruments. Among the instruments is Hartman's absolute tangent galvanometer. The sum of $400 has already been expended in determining the strength of the earth's magnetism in the spot where this instrument stands. There is also a Thompson astatic galvanometer of 5,000 ohms, made by Carpentier of Paris; a Wiedemann with movable coils, and a high resistance galvanometer of the Troy make; two resistance boxes of the Elliott Bros., London—one of 10,000 and the other of 11,100 ohms, with bridge; a potentometer; a microfarad condenser; and a Thomson's absolute electrometer from White of Glasgow. There is a separate battery room with seventy cells of different make

Into the laboratory room runs a local telegraph line extending through the town for about three miles with eighteen stations. This line is used for instruction in testing daily for insulation, resistance, crosses and leaks. Heavier electrical work is carried on in a recently erected engine house of stone, 80x50 feet, with a 110 feet smoke stack. There are three floors. An American 10 arc light plant is in this building. A Carpentier voltmeter and ammeter, a Brackett cradle, large enough to hold the dynamo entire, a Prony brake and a Crosby indicator will admit of all sorts of measurements and tests of the dynamo and engine. It is proposed to add an incandescent and converter system soon.

Lawrence is well supplied with electric light plants. Besides the one at the university, there are four in the city. Two are independent electric light plants; one is connected with the water-works, and the fourth is connected with the gas-works. The gas company recently contracted with the Kansas City agency of the Thomson-Houston company for 70 arc lights. B.

Indianapolis Items.

INDIANAPOLIS, Ind., June 16.—The Indianapolis Jenney Electric company last week shipped a complete electric lighting plant to Stockton, Cal., besides filling a large order from San Bernardino, Cal., for additions to the present plant.

The principal question attracting the attention of the city council is that of street lighting, and from present appearances the gas company will continue to furnish light for some time to come. The resolution as adopted by the council last week came up before the board of aldermen this week and they amended it by striking out all of that part referring to any other than electric lighting. The question was then referred back to the city council, who refused to receive it with the amendment. At a special meeting of the board of aldermen held last night they adopted the resolution as it came from the council. There was too much of a desire on the part of many members of the council and aldermen to get away to Chicago to look after political matters to settle details in regard to bids.

No further action has been taken in street railway affairs. The electric company are at a standstill.

L Johnson, of Terre Haute, has sued out a writ of attachment against the Heisler Electric Light company, which has just put in a plant at Wabash, Ind. Johnson was formerly in the employ of the company as agent, and claims to have secured the contract for putting in the plant at Terre Haute, and that the sum of $600 as commission is due him on that account. The Heisler people denounce his claim as preposterous, and have employed counsel to fight the matter to the bitter end.

The Heisler system just completed at Wabash is giving entire satisfaction. There are 127 incandescent lights scattered through the city. M.

From Ottawa, Ill.

OTTAWA Ill., June 16.—The Ottawa Electrical Street Railway company, with a capital stock of $100,000, was chartered on the 11th inst. Thos. J. Evans of Council Bluffs, Iowa; G. S. Eldridge, W. E. Bowman and James Briggs, of Ottawa, are mentioned as the incorporators. The company mean business and have already applied to the city council for a franchise to build a railway in the city. It is proposed to put down about six miles of track covering every portion of the city. The proposition is to have two miles of the road in operation by December 1st next, and the entire plant equipped by June 15th, 1889.

At a special meeting of the city council on the 12th inst. the proposition of Messrs. Evans and others was adopted and the law and ordinance committee instructed to confer with the street railway company and draft a suitable ordinance. The electric people were a little surprised in not meeting with opposition in the council from the gas interest. The passage of the ordinance for the electric street railway will be watched with interest. The motors to be adopted on the road will be of the Thomson-Houston system, with overhead wires. Cars will run during the busy hours of the day at intervals of five minutes.

The Central Union Telephone company have equipped the public station at Mendota with a long distance transmitter.

Your correspondent, while in Mendota this week, met the genial secretary and treasurer of the Mendota Electric Light company, Max A. F. Haass. This company are doing a nice business and expect to add 500 lights to their plant this spring. The Westinghouse system, in connection with the Thomson-Houston arc light, is in use.

At the last meeting of the Ottawa city council an order was issued to light the bridges over the Illinois and Fox rivers and Washington Park by electricity. The electric light company are jubilant and consider this the opening wedge to the ultimate lighting of the entire city.

Prominent gentlemen have been at La Salle this week looking into the feasibility of building an electric railway connecting La Salle, Peru and Spring Valley. The distance between these three cities is but five miles, and the combined population is now 22,000. The travel between them is already enormous, while the facilities are poor. It is thought with a good street railway a great benefit will be confered upon the citizens and a profitable business established for the builders of such a road. The projectators propose to use electricity.

The Thomas Electric Light and Power company have more orders for arc lights than their plant will carry. C. L. Ballard, manager for the Western Union Telegraph company, is their electrician.

The Marseilles Water Power company, 8 miles east of Ottawa, on the Illinois river, at the manufacturing town of Marseilles, have concluded negotiations for the putting in of an incandescent light plant. The system is to be the Heisler. E.

From Detroit, Mich.

DETROIT, MICH., June 18.—Articles of association of the Hicks' Induction Light and Motor company were filed to-day. The purpose of the organization is to "manufacture apparatus for the generation and application of electricity." The capital stock is given at $400,000 paid in. The stockholders are: Thomas H. Hicks, 2,200 shares; Elkanah D. Richmond, 2 200; Peter Duffus. 2,200; S. Olin Johnson, 319; J. E. Guilbaut, 960; J. E. Lockwood, 2,200; David Pennock, 960; Charles H. Lee, 960; treasury stock, 4,600; Homer Pennock, 1.

The Gamewell fire alarm system has been established at Lansing, and work for one at Muskegon is well under way. C

THE ELECTRIC LIGHT.

Allegan, Mich., will be lighted by electric light.

The Natchez Gas Light company will add an electric light plant to its works.

The common council of Pierre, Dakota, is considering the advisability of granting an electric light franchise.

The Western Electric company of Chicago will install a plant of twenty arc lights in the factory of the Brown Bros.' Manufacturing company, corner of Jackson and Clinton streets, Chicago.

J. D. Simpson, S. D. Kerr. A. H. Hampton, A. Stewart, H. P. Thompson, and others have formed the Winchester (Ky.) Electric Light and Power company. They have contracted for machinery. The Edison system will be used. The capital stock is stated to be $15,000.

"Electric light companies are beginning to realize the need of a better insulation," said a gentleman interested in the sale of wire. "They are beginning to appreciate fully that underwriters' is not good enough. Consequently the sales of higher grades of insulation are better. The gentlemen who have investigated the subject are now willing to admit the absolute necessity of higher insulation."

The Thomson-Houston Electric Light and Power company has been incorporated at Hampstead, N. Y., with a capital stock of $75,000.

The whole of the lighting of the British cruiser Medea, which has just been launched, will be provided by electricity, and there will be three search lights of the most powerful character.

George W. Frank, of Kearney, Neb., closed a contract with George W. Coster, of Omaha, for a complete Edison plant for incandescent lighting. The Western Engineering company of Lincoln will do the constructing, and furnish Sprague motors for the electrical transmission of power for the city of Kearney. The plant is to be run entirely by Kearney's great water power.

The Waterhouse Electric company, through their Cincinnati representative, W. N. Gray, has placed a 30-light plant in the famous picnic ground known as the 'Coney Island of the West," near Cincinnati, and has also sold a plant to the Ohio penitentiary at Columbus, O., the latter to be used principally for lighting the space just inside the walls, to aid the guards in preventing escapes.

The growth of the electrical department of the Oakland Gas Light and Heat company of Oakland, Cal., has been marked during the last year. June 1st, 1887, the company was operating about 100 arc lights of the Thomson Houston system. The company is now furnishing over 200 arc lights, and has ordered additional apparatus of the Thomson-Houston company, to make the total number 250. A new compound condensing engine of 350 horse power has been ordered, and additions will at once be made to the existing station, to allow of an increase to 600 lights.

The building of the Edison Electric Light company in Boston, which recently was burned, was intended to be fire proof, and would, in fact, have been so but for one fatal error—the walls and ceiling were sheathed with varnished wood and a wooden floor covered the brick and iron in the dynamo room. All this wood was as dry as tinder, so that when the fire broke out it had abundance of material to feed on, and the fourteen dynamos, with all the other apparatus in the room, were completely ruined before the fire department succeeded in quenching the flames.

The central station of electric lighting now actually at work at Amsterdam presents certain interesting features. The station being situated very near the places to be lighted, the engineers have passed over the high potential system and alternate current system, and instead have adopted the system of distribution at 100 volts. The current is furnished by two dynamos driven at 100 revolutions only per minute, by a direct driving steam engine of 240 horse power, by this means obviating any risk of stoppage from gearing or belts. In addition, the attendance required is very small.

Mayor Hewitt, of New York, has suggested that an examination be made to see if there are really thousands of dead electric abandoned wires in the streets of the metropolis. If there are, he says, and the owners can not be identified so as to be charged with the task of taking them down, the department might properly employ for that purpose the money for removing incumbrances. "I invite your early attention to this matter," he says, "as it seems to be one of the consequences of the inconsiderate action of the board of electrical control, for which no provision has been made, and which, therefore, must come within the control of your department."

"Not many years ago we had the pleasure of meeting a gentleman, whose name we have since recognized as that of an ardent champion of local electric lighting," says the London *Electrician*, "and who held and still holds an honored position in the councils of the local senate in a certain cathedral city. This gentleman assured us that to him personally belonged the honor of introducing the electric light into the west of England, but that 'until he bought one and brought it home and tried it for himself' he never did or could believe in the possibility of electric lighting. Our curiosity having been thus aroused, we were invited to inspect the arrangements at his place of business. We went there and were shown—an electric gas-lighter!"

An interesting war is going on in Booneville, Mo., between the electric light company and the gas-light company. The gas company is one of the oldest institutions, and has something like $20,000 invested in its works. The city voted a month ago to have electric light also, and the contract was awarded to C. B. Rhodes, of Lamar, Mo. A suit was recently filed testing the validity of the electric light election. At the last meeting of the city council the mayor made a spirited attack upon the originators of the suit, and had a committee appointed to investigate it, and to institute immediate suit to have the gas company's charter forfeited. The gas company is operating now under a loss, and, with the electric light company organized, the prospects are not very flattering for either company, as there are not consumers enough here to sustain them. Just how the fight will terminate no one knows.

Last Friday's storm developed a new danger from the electric light wires, says a New York paper of last Sunday. At Tompkinsville, Staten Island, and in the neighborhood of Forty-third street and Eighth avenue, in this city, accidents happened to the wires which might easily have caused great destruction of property and the sacrifice of human life. At Tompkinsville a heavy electric light wire was snapped by a surcharge of electricity. Fortunately it fell in the middle of the road, where it lay emitting "thousands of sparks." As it fell it came in contact with a nest of telegraph and telephone wires, which it instantly burned through and severed. If it had fallen upon a human being or fallen on a building the consequences may be imagined. In this city two Brush wires were thrown together, and a disconnected Brush wire in a drug store emitted sparks which drove everybody from the building. It was some time before an electrician arrived to remove the danger.

The burning of the Edison electric light station, in this city a few night since, suggests the need of duplicating electric light stations, or at least dividing then into two or more separate sections. The burning of this plant caused a large theater and a prominent hotel to be left in darkness, besides the inconvenience experienced by a hundred small patrons of the incandescent light. It is possible by dividing the plant, or by establishing a reserve annex, to prevent the destruction of the whole plant by a single fire. Some of the New York daily papers support in idleness an office sufficient to get out their papers should the regular plant be destroyed. These supplementary plants are located at a distance, and both are not likely to be destroyed by anything short of a bombardment by foreign cannon. The extra expense caused by dividing an electric light plant would not be as great as that incurred by maintaining a duplicate plant in idleness, and by such a division of power, and suitable switch-board connections, the fire fiend could never extinguish an entire system of lights.—*Manufacturers' Gazette.*

At the Chicago Electric club some discussion recently took place on a point which will most likely come under consideration before long in this country, says the London *Electrician* of June 1st. It is agreed that within a certain limited area a simple parallel distribution is the cheapest. Supposing, then, it be decided to light a district by alternating transformers, the question is whether a commencement should be made in the area immediate y around the station with direct currents. We have heard several people express an opinion in favor of this plan, and it also appears that it has commended itself to many electricians in America. But from the discussion above alluded to we gather that practical experience does not recommend it. Mr. Cutter, of the Thomson-Houston company, spoke very strongly in favor of a single unmixed system for central station work. A mixed system is nearly always more expensive to work; it necessitates additional reserve plant, and is likely to lead to mistakes on the part of the employes. We are, moreover, inclined to think that in this country it is especially undesirable to go through the early—and to some extent experimental—stage twice over. The slight additional first cost of transformers in the nearest houses will probably pay for itself by the additional experience gained, to say nothing further of the extra cost of the mixed system to which allusion has already been made.

Maj. E. C. Browne, an Englishman, writing about the acquisition of Burmah by the British, describes the effect upon the natives of the first exhibition of the electric light. "A great ray of soft light," he says, "shoots across the heavens from horizon to horizon. A flood of light is cast on a spot in the village, but it is off with more than lightning rapidity to illumine another. It heaps and bobs and bounces about the earth in most uncanny fashion. The village is illumined. It visits every portion of it and seems to enter at the doors and windows. At first the people rush away, but, finding that in many cases the light follows, they throw themselves down with their faces to the earth. In a few minutes the village and river banks are cleared, and the terrified people take refuge in the bush or at the backs of the houses. But this only lasts a very short time. Curiosity is stronger than prudence. So far the light has struck no one dead. Perhaps it may be harmless; so the children, clinging to each other, venture into the glare, then run to their mothers' arms screaming half with fear and half with delight. Some of the big boys then rush out, have a good stare, and having dared so much once more disappear. The ladies seem to gain confidence next to the children. Their curiosity can not be restrained any longer, so they get together in groups and hide their faces and scream and giggle. Some of the more cheeky ones actually put out their tongues at us and begin dancing and gyrating about. The men, last of all, moodly emerge from their cover, and, still not half liking it, walk cautiously about, and gradually the village is gay."

THE ELECTRIC MOTOR.

The Mikado has commissioned an engineer to visit the United States to gain information with the intention of introducing electric railways into Japan.

The report of the Richmond Union Passenger railway for the month of May shows 50,430 miles run and 242,282 passengers carried. The total operating expenses, including everything, was only 47 per cent. of the receipts.

The Sprague company have just sold one 20 and one 30-horse power motor to parties in Nebraska, to be used in operating machinery for making brick. This is the first application of this nature so far made with such large motors.

The Silvey Electric company, of Lima, O., has completed the large motor which they have been building for the street railway of that place. Last week a trial trip was made with it over the line, and the work was quite satisfactory.

The Sprague Electrical Equipment company of Chicago has been incorporated with a capital of $50,000. The company intends to install electrical machines. It will be distinctly a construction company. The Sprague Railway & Motor company's object is to sell machines, and the local company proposes to install them.

In Paris recently Captain Renard exhibited a single fluid battery, which he claims far surpasses all previous batteries in its results and cost of maintenance. The first cost, however, is greater, the cells being of silver, with platinum thickly deposited outside. It is worked with a chloro chromic solution. The battery is remarkable for the smallness of its weight for the work given, and also for its constancy. He proposes using these batteries for aerial propulsion in the French army.

The new electric motor for propelling street cars will soon be tried on the Lombard and South streets branch of the People's Passenger Railway company, Philadelphia. Workmen are now busily engaged relaying the tracks with the new rail used for cars provided with the Wharton motor. Eight-wheel cars instead of four will be used. They will be large enough to comfortably seat thirty-four persons. The weight of each car will be 14,600 pounds. An experimental car will first be run on Fourth and Eighth streets, and if it is found practical the cars will be operated on the Lombard and South streets branch.

The Lima Street Motor and Power company have purchased a 100 horse power generator of the Silvey Electric company of Lima. This motor was being made for exhibition at the Cincinnati Centennial Exposition, and was being finished up for that purpose, when sold to the motor company. It is one of the largest generators ever constructed. The generator heretofore in use in the station is but 60 horse power, while the cars run by it are 65 horse power. In addition to this will be the 15 horse power motor, now being built by the Silvey company. The two generators will both be run, and the company will then be in shape to furnish motor power to the different industries about the city.

We may confidently look to see the speedy introduction of the electric motor for crowded local transportation, says the *Commercial Advertiser*. The state of the art has now reached a point where all may witness the principle actually applied and working satisfactorily under the ordinary conditions of daily life. A number of rival systems, each, no doubt, possessing merits of its own, compete for recognition as the best; but this antagonism is a sign of health. Very likely there will always be such a competition, just as we find different makes of sewing machines or steam engines. But the main fact is that the utility of electricity as a motive power for railway transportation has now been demonstrated, and is rapidly coming into use. Experience must decide among rival systems in the light of the record of each, and of the peculiar conditions of locality.

The Fourth Avenue Street Car company of New York before deciding upon electric motors appointed experts to make calculations as to the ratio of cost, gain and loss in the three methods of propelling street cars. The following are the results:

	Electric.	Horse.	Cable.
Cost of cars	1	.54	.81
Motive power	1	1 45	1 06
Construction of roadway	1	0.53	2.09
Depreciation and repairs	1	1.47	2.04
Operating expenses (including wages)	1	3.38	1.71
Totals	5	7.37	7.74
Average	1	1.47	1.55

A New York dispatch says a boat run into New York harbor by electricity was anchored off pier one, North river. She is a trim little launch twenty-eight feet long, having six feet of beam and three feet of depth. Two long benches run fore and aft in her, back to back. Under them are storage batteries. The motors are aft under the deck. A trap-door opens and reveals a 7 horse power motor for full speed, and a 2 horse power motor for half speed. They are regulated by a handle convenient to the steersman, for whom there is a comfortable seat in the stern, and they drive a screw propeller. A handsome canopy covers the little boat, and from each of the eight posts hangs an electric light. Frederick Reckenzaun brought a party of friends over from Newark. The large motor will give a speed of twelve miles an hour, and the small one a speed of seven or eight.

The electric road in San Jose will soon be in operation. Two dynamos have been substituted for the old dynamo which has been in operation. Mr. Fisher of the Detroit Electric company said of the reasons for making the change: "First, because the unit of measurement was too large with the single dynamo. In the day-time six cars will be running, and at night only three; yet it would be necessary with the big dynamo to keep up a force sufficient for the whole, which would require a great deal of fuel. With two small dynamos, one of them can be shut off during the evening and the work done with a single one, thus enabling the company to save fuel. Second, the two dynamos will enable the company to maintain easily two grades of speed. A third advantage is that in case of any accident to the dynamos the road will not have to shut down, as each of these dynamos is amply strong enough when run at its full force to move all the cars on the road. Another great gain which results from two dynamos is that it enables the company to divide the road into four circuits—two in each of the eastern and western sections, and if anything should occur to stop the cars in one circuit the others could still go on. Work is now being done on the track between here and Santa Clara. We intend to have as perfect an electric road as there is in the world, and we are working to that end, but I cannot fix a date when the road will be running."

THE TELEPHONE.

Judge Blodgett's decision in the Bell-Cushman telephone suit is expected not later than the middle of next month.

The Joliet Telephone company has reduced its rates to $54 for business firms and $36 for residences. There is great rejoicing in Joliet.

The telephone system of Milwaukee was disabled on June 14th. A heavy storm occurred during the morning, and the Michigan street cable was struck. About three hundred telephones were rendered useless. The loss will be considerable. The police and fire alarm systems were damaged by the lightning.

C. D. Warner, Ansonia, Conn., has been conducting experiments recently, the object of which was to ascertain the fact of electric current escaping from the rails of the electric car track, which is said to have caused the local telephone company considerable trouble and anxiety. The experiments demonstrated that sufficient electricity escaped in places to operate a 16-candle power incandescent lamp to its full capacity.

Chief Engineer Kearney, of the Board of Electric Control of New York, said recently: "We have spent $750,-

000 in laying the electrical subways, and have dug about twenty-nine miles of trenches, which contain about 312 miles of single ducts. Through these conduits have been drawn between 4,000 and 5,000 miles of telegraph and telephone wires, all of which are in use; and the conduits which are still unused among those reserved for the telegraph and telephone companies are being filled with wires as fast as they can get their cables from the manufactory." Additional subways are being laid in the lower parts of the city. Above Fourteenth street iron pipes are used, laid in cement, elsewhere vitrified pipes and wooden logs, likewise imbedded in cement.

THE TELEGRAPH.

The Columbia Improvement company has been incorporated at Tacoma, W. T., among other things, to construct and operate telegraph and railroad lines.

The new law suppressing bucket shops in Canada will, it is reported, inflict a loss of at least $130,000 per annum upon the telegraph companies. The yearly contracts between the bucket shops and the companies for special wires will be canceled.

The Trinity and Shasta Telegraph and Telephone company has been incorporated at Weaverville, Cal. The capital stock is $10,000. It is expected to have the line in working order by the first of August next. The line will probably connect with the Western Union telegraph lines at French Gulf, Shasta county.

Exhibitors of electrical devices are invited to confer with any member of the following committees of the Association of Railway Superintendents, which meets at the Murray Hill hotel, New York, July 11th: Committee on electrical devices: Charles Selden. Committee on space: Messrs. W. J. Holmes, S. S. Bogart. C. E. Topping, New York.

The Western Union directors last week declared a quarterly dividend of 1¼ per cent. The books will close June 20th. The statement of the company for the current quarter estimates the gross earnings at $5,000,000 and the net earnings $1,350,000. The fixed charges and dividends require $1 220,000, leaving a surplus for the quarter of $130,000. The gross earnings for the quarter are larger than ever before in the history of the company. The net earnings for the previous quarter fell below the estimate on account of the blizzard, and were not sufficient by $66,817 to meet the dividend payment.

The immense telegraphic facilities it required to distribute the proceedings of the democractic national convention to the press may be judged when it is stated that the Western Union Telegraph company alone handled and transmitted over the wires an aggregate of 2,151,791 words. This consisted of regular press reports, special dispatches to the leading journals of the country, and bulletins which were flashed over the wires to every city and town in the land. Of this great amount of news the Associated Press furnished nearly 200,000 words. In addition, 57,426 messages, averaging perhaps fifteen words each and pertaining directly to the convention and its result, were handled by the Western Union company, making a grand total of almost 3,000,000 words, or nearly 2,000 newspaper columns.

Personal Paragraphs.

F. W. Horne, of Chicago, has returned from his eastern trip.

J R. Dee, of Houghton, Mich., was in Chicago this week.

W. J. Buckley has returned to Chicago after a trip in the south and east.

Col. George L. Beetle, of the Western Electric company, is home from an eastern trip.

C. H. Decker of the C. H. Decker Electrical company of Detroit, Mich., was in Chicago recently.

R. T. McDonald, general manager of the Fort Wayne Jenney Electric Lgiht company, was in the city the 16th.

Samuel H. Lowe, chief editor of the Rochester, N. Y., *Morning Herald* was a welcome visitor to the WESTERN ELECTRICIAN office this week.

E. J. O'Beirne, formerly of the Star Iron Tower company, will represent the Thomson-Houston company in Mississippi, with headquarters at Jackson.

The executive committee of the Chicago Electric club have appointed C. C. Haskins custodian and have made the position a salaried one. The selection of Mr. Haskins for this position was a wise one.

James W. Stanley of Rochester, N. Y., one of the brightest of general eastern newspaper correspondents, made the WESTERN ELECTRICIAN his headquarters this week while in attendance on the national republican convention.

R. H. Browne, of Chicago, the electrician in charge of the Litchfield Electric Light and Power company's plant in Litchfield, Ill., and Miss Nellie B. Marion, of Litchfield, were united in marriage June 14th, Rev. D. V. Snowden, D.D., officiating.

E. M. Barton, president of the Western Electric company, left for the east Monday. Mr. Barton will sail for Europe with his family, June 27th, on the Northern German Lloyds steamship Trave. Mr. Barton will be abroad but a few weeks, but his family will remain in Europe for some months.

Secretary McPeck, of the Marysville, O., Edison Electric Light company, was in Chicago the early part of the week. His testimony to the great perfection of the running of the plant with which he is connected is to the point. Since the plant was started it has not been shut down for a minute during running hours.

H. J. Wells, of the Midland Electric company of Omaha, Neb., and James Donnelly, Jr., superintendent of the American District Telegraph company, of the same city, passed through Chicago Monday last on their return from a Knights of Pythias convention at Cincinnati. Business in Omaha they characterize as brisk.

At a meeting June 9th, of the special committee appointed by the common council of the city of Detroit, to examine and report upon the feasibility of the city owning and operating its own electric lighting plant, the following resolution was offered, and carried unanimously:

"That the thanks of this committee be, and they are hereby tendered to Fred. H. Whipple, secretary of the committee, for the very able, exhaustive and comprehensive manner in which he has discharged the laborious duties assigned to him, in preparing and compiling the information and facts connected with the subject relegated to the committee. We consider his work, as completed, to be beyond all question the most valuable digest of the matter that has ever yet been produced, and cheerfully recommend it to all who are interested in the subject of municipal lighting."

Miscellaneous Notes.

A dispatch from Parkersburg, West Virginia says: During a thunder storm at Mason City John Coplen, a wealthy citizen, while in a shed was struck by lightning, the discharge entering his clothing just under the left arm, tearing his clothing entirely away to his feet and leaving nothing but the sole of his boots. Strange to say the man is sitting up, with every prospect of recovery.

A dispatch dated Philadelphia, June 13th, says: A communication was received a few days ago by the J. P. Morris company, builders of mining machinery, from the Calumet and Hecla Copper Mining company of Michigan, countermanding an order for some powerful engines given to the Morris company some time ago. It is inferred that the withdrawal of the order, which would require two years to fulfill, means that the Calumet and Hecla mines are going to shut down and stop their output of copper at the command of the foreign copper syndicate; not suddenly, it is supposed, but nevertheless finally.

This story is sent from Pittsburg, Pa.: Five months ago Annie, the 10-year-old daughter of James Evans of Youngstown, who has been known in all the principal cities as the "Stage Prodigy" since she was 5 years old, lost her voice while singing in public. Medical skill was of no avail. She was only able to speak in a whisper and was gradually getting worse. Last night during a storm she was at an open window. A vivid flash of lightning followed by a loud peal of thunder frightened her so that she screamed. This had the effect of restoring her voice, which is now as strong and flexible as at any other time in her life.

The *American Meteorological Journal*, desiring to direct the attention of students to tornadoes in hopes that valuable results may be obtained, offers the following prizes: For the best original essay on tornadoes or description of a tornado, $200 will be given; for the second best, $50; and among those worthy of special mention $50 will be divided. The essays must be sent to either of the editors: Prof. Harrington, Astronomical observatory, Ann Arbor, Mich., or A. Lawrence Rotch, Blue Hill Meteorological observatory, Readville, Mass., U. S. A., before the first day of July, 1889 A circular giving fuller details can be obtained by application to Prof. Harrington.

Thunder seems to have a peculiar effect in restoring the vocal powers of dumb persons. The following report, which comes from Youngstown, O., is almost identical to the story given in the last issue: Nannie Evans, aged 10, while singing at a concert a year ago, strained her voice, resulting in paralysis of the vocal cords and her inability to speak only in the faintest whisper. Physicians were unable to render any relief, and recently her articulation steadily grew weaker. Last night, while standing at a window watching a storm, two flashes of lightning, followed by heavy thunder, occurred that shook the house. The child ran to her mother, exclaiming: "I can talk as well as ever," speaking in a clear voice. To-day she is able to converse distinctly, and it is believed has permanently recovered her voice.

H. N. Warren describes in the *Chemical News* an apparatus for the electro-crystallization of copper. The apparatus consists entirely of an open tube, closed at one extremity by means of a bladder diaphragm, and suspended in a solution of dilute sodium chloride. Into the tube is introduced a saturated solution of cupric sulphate, the strength of the solution being maintained by the insertion of a smaller tube terminating in a point, and containing crystals of $CuSO_4$. A strip of copper foil, about 3 inches long by 1 inch wide, is next introduced into the copper solution, and connected by means of a copper wire to a plate of zinc, forming the negative electrode and in contact with the salt solution. After the lapse of a few hours small cubical crystals of metallic copper gradually begin to appear on the copper electrode, which in the course of a week or more will have arranged themselves into a compact crystalline mass, posessing a full metallic luster, and rivaling in purity and malleability the finest specimens of native copper, which they much resemble. Metallic silver, antimony, bismuth, zinc, and even aluminum, magnesium, iron, chromium, and all the more oxidizable metals, may by slight alterations be reduced to the metallic state.

A dispatch from Ansonia, Conn., says;— One of the drawbacks experienced by the people of this place in connection with the newly opened electric street railway is the magnetization of their watches. While it is true that watches will suffer no injury if the wearers keep away from the motors in the forward end of the cars, the natural curiosity of the Connecticut Yankees to "see how the thing works" leads many of them to go too near the machine, and many fine watches have become so highly magnetized as to be practically useless. To put them back into good working order again it has been necessary to send them to New York, where they were demagnetized, a rather expensive operation. One timepiece which was injured by too close contact with the motors was owned by Dr. W. H. Pulford, jr., a homœopathic physician. He tried to devise some way of remedying the difficulty without going to a heavy expense, and recollecting the diffusive qualities of the ground in electricity, he hit upon a plan. He enclosed his watch in a cloth bag, and buried it in a large box of damp earth. Here it remained for three days. Yesterday he dug it up, and after twenty-seven hours' running the watch has not varied a hair, whereas before it would not run at all. The simplicity of this process of demagnetization of watches recommends itself to the owners of damaged watches, while the jewelers who have been reaping a harvest from this source ridicule it.

The Chicago *Daily News* says of the history of the North Side Cable road and the inadvisability of extending the system to the west side: "Three months have elapsed since the North Side cable was inaugurated. During this period every possible test of its capacity has been made, with the result considered inevitable by every one who was familiar with the "Cheap John" process of construction. The engines, according to experts who have examined them, do not furnish more then one-third of the power that should be required for successful operation. Additional power would entail the construction of larger pulleys and an entire change of the system. The power houses are not large enough for more engines. The conduits would have to be increased in size to accommodate larger pulleys and cable. Baron Yerkes cannot take the horse cars off Clark street for the simple reason that the cable is not powerful enough for the traffic alone. As it is, scarcely a day passes without the inevitable breaking and blocking, until the North Side cable has come to be viewed as an unmitigated nuisance and an outrage on the public. When the cable breaks all the horse cars are also blocked, and when both are running the cable cannot get up speed because it is prevented by the horse cars. The West siders simply ask to be spared from such a dilemma.

The Edison laboratory is much visited by teachers just at present. This story is told by the Newark *Journal:* Of all the departments visited by the teachers, none afforded so much delight and wonder as did that in which Mr. Edison is perfecting his wonderful talking doll. As the teachers filed into the room Prof. Kennelly picked up a doll from a table. "This," he said, "is Mr. Edison's talking doll." The doll was an ordinary thing and it wore a red Mother Hubbard dress. "I will now remove its dress," said the Professor, "and show you how it is worked." The teachers became noticeably nervous, but they bravely stood their ground. The professor then quickly unbuttoned the waist of the little creature, displaying a tin chest, which with the head and shoulders he lifted from the rest of the body. "This baby has no lungs," he said "and unlike other babies will only talk and cry when you make it. He then showed how the doll works. The phonographic machinery is all placed in its body, and from its chest a small crank protrudes. By turning the phonograph is operated, and the doll speaks One of the speaking machines was on the table, and Prof. Kennelly showed how it worked. It is a little larger than the machine intended for the talking dolls and is not yet quite perfected, the articulation being indistinct at times. The professor applied his hand to a crank at the side of the machine. A funnel, like a cornucopia, was attached to the machine, and as the crank was turned out came the words

Twinkle, twinkle, little star,
How I wonder what you are.

Good-night, mamma, good-night,
Mamma, I love you,
G-o-o-d-n-i-g-h-t.

The words could be heard in every part of the room, and the audience was filled with wonder. The words were repeated again and again. As a sentence is spoken into the phonograph, a needle makes indentations upon a wax cylinder to correspond with the waves of sound. As these indentations do not wear out, the same words can be repeated as often as desired. Certain sentences will be placed in the phonographs in the dolls, but those who purchase the toys can procure wax cylinders containing other words, and so have the doll armed with a variety of sayings.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	350	375
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	27	28
Missouri and Kansas	70	71

Business Mention.

John C. Liggett has opened an office for the Franklin Electric Motor company of Detroit, Mich., at room 21, 163 State street, Chicago. Mr. Liggett says the prospect is excellent for disposing of small sizes of motors.

S. Taussig, agent for synovial oil, 45 River street, Chicago, points with pardonable pride to the record his oil is making. For instance, fifty gallons of synovial oil ran ninety arc lights 850 hours, and 400 incandescent lights have run over eleven months on one barrel of synovial oil.

Do you want anything in the way of electrical supplies? If so, write to the Partz Electric Battery company, 636 Arch street, Philadelphia. Their batteries have a world-

wide reputation, and the motors they are now manufacturing will become equally well known. Send for their catalogue, and also state in a letter what you require.

J. W. Godfrey of the New York Insulated Wire company makes brief visits to Chicago, but he makes his time count while here. A million and a half feet of wire will be shipped from New York to the west as the result of his last visit.

The Fort Wayne Jenney Electric Light company of Fort Wayne, Ind., have recently issued a catalogue describing the Slattery induction system for long distance lighting. The pamphlet is illuminated by the handsome cuts of the details of the system, made and published by the WESTERN ELECTRICIAN some weeks ago.

The Ansonia Brass & Copper company, of New York and Chicago, have recently issued a neat pamphlet devoted to Cowles' fire-proof and weather-proof line wire. This wire was placed on the market six years ago, and its merits have won for it an enviable reputation, so enviable, in fact, that the purpose of the pamphlet is to warn the public against imitations.

Under date of May 31st, J. A. Duncan, agent of the Sprague company at Pittsburgh, Pa., writes that the motor business there is very good indeed, and constantly increasing. He has recently installed a large number of motors and has many more already spoken for, and in every single instance they are giving complete and entire satisfaction to the users.

The Heisler system has been adopted at Hackettstown, N. J., for street and commercial lighting, and a plant has been erected by White & Rusling, agents for the company, of 137 Broadway, New York. The contract was signed and the order sent for the electrical appliances May 1st, and the apparatus was tested and the lights turned on for the first time on the 2d of June, which is putting up a plant on pretty short notice.

Of the many instances seen every day of the superiority in the economy, reliability, and cost of maintenance of electric power as demonstrated by the Sprague motor, one of the most satisfactory is the experience of L. J. Wells, of 113 Fourth street, Des Moines, Ia., who says: "I have been using a 3-horse power Sprague electric motor for nearly three years, running elevator hay hoist, pump, horse-cleaners, and ventilating fan. It has not cost me one cent for repairs and saves me at least $600 a year."

Chas. A. Schieren & Co., of New York, report recent sales of electric leather belting to the following concerns, for use on dynamos: Church Green Electric Light company, Boston, Mass; Richmond Light, Heat & Power company, St. George, S.I., N. Y.; Winchester Electric Light company, Winchester, Mass.; Elizabeth Electric Heat & Power company, Elizabeth, N. J.; Long Island Electric Light company, Woodhaven, L. I.; Elizabeth Schuyler Electric company, Elizabeth, N. J.; Brush Electric Light & Power company, Savannah, Ga.

Chas. A. Schieren & Co., of New York, have issued a circular letter in which they say: "Information has reached us that attempts have been made to imitate our celebrated electric leather belting, and we take this opportunity to inform our patrons and the trade generally that we have the exclusive right to use the word "Electric" as applied to leather belting. This right is granted us by registration in the patent office of the United States of America, dated November 17th, 1885 and numbered 12,785, and we hereby notify infringers that they will be prosecuted according to law."

W. F. & John Barnes & Co., of Rockford, Ill., have recently issued a catalogue and price list of interest to electrical manufacturing companies, particularly those in need of small screw-cutting lathes. These machines have back gear, reverse feed and hollow spindle for rod work, making them complete tools in every respect. Among electrical companies using these tools are the Houston Electric Light & Power company, Houston, Tex.; Jenney Electric company, Indianapolis, Ind., Mobile Electric Light & Power company, Mobile, Ala., Pueblo Electric Light company, Pueblo, Col.; Electric Gas & Power company, Laramie, W. T. Chas H. Besly & Co., of Chicago, represent the manufacturing company.

The electric light committee of the city council of Urbana, O., has reported in favor of granting a franchise to the Excelsior Electric company, F. W. Horne, Chicago, western agent. This decision is a feather in Mr. Horne's cap He heard at the eleventh hour that the matter was under consideration, and hurried off to Urbana, post haste. He reached there just in time to get his bids in twenty minutes before the time for closing. All the best systems were represented and the matter was presented to the council with many arguments by the several agents. The lights will be sold to a local company. Sixty arc lamps will be employed for street illumination and the same number for commercial purposes. The Philadelphia moon schedule was adopted for the city lamps. A Westinghouse incandescent plant will also be installed by Mr. Horne for the local company.

P. A. Dowd & Co., New York city, agents for the Sprague Electric Railway & Motor company, report sales of the standard motors the past week as follows: Brown & Rittinhouse, 139 Reade street, 10 horse power, elevator; John A. Willet & Co., 137 Reade street, 10 horse power, elevator; Rufus L. Cole, 141 Reade street, 5 horse power, elevator; P. Dauphin, 151 Fulton street, ½ horse power, machinery; Lehr & Lock, 37 John street, 1 horse power, machinery; Heller & Birdel. 22 Maiden Lane, 1 horse power, machinery; John Robinson & Co., 45 Murray street, 2 horse power, elevator; C. G. Braxmar, 36 Cortland street, 1 horse power, machinery; Lazell, Dalley & Co., 110 Beekman street, 7½ horse power, elevator and machinery; Kalle & Co., 77 John street, 5 horse power, machinery; James S. Barrow & Co., 141 Chambers street, 5 horse power, elevators; Gold & Stock Tel. Co., 16 and 18 Broad street, 5 horse power, transmitters; Thurber, Wyland & Co., 143 Chambers street, 3 horse power, printing presses; Whitelaw Reid, editor of the *Tribune*, 2 horse power, pumps, etc.

The Vale Royal Manfg. Co., formerly D. C. Bacon & Co., of Savannah, Ga., replying to an inquiry from the Woodbury Engine company, of Rochester, N. Y., as to the amount and kind of work they did with some of their 10" by 12" center crank, slide valve engines, wrote: "We use them as auxiliary engines in our business—run gang edgers, cut-off saws, lath, shingle and stave machinery. We should not hesitate to say they would each cut 5,000 to 7,000 feet of one-inch lumber from yellow pine a day, with engine and saw in good order. The writer, with forty years' experience as machinist, engineer and proprietor of engines and machinery, will say he considers your engines excel any others he has seen in the following points: 1. The quality of the metal used, which is one of the most important factors in an engine. 2. The simplicity of the engines. 3. Large wearing surfaces. 4. General proportions of the different parts. 5. Good workmanship. I have a "14 by 21" engine of your make which has been running over two years. We have never taken off a cylinder head or packed a stuffing box on it. We run 150 revolutions per minute, ten hours per day, and the engine has not cost us a cent. A boy at 90 cents per day gives it all the attention it needs. Once in six months for large end of rod, and once a month for small end, is often enough to key it up, and I see no reason why the engine should need repairs for twenty years. Understand, the engine is well put up. A nickle will stand on edge on the back cyl inder head all day long. There is no working out of line. We have no interest in your engines, but do a simple act of justice in writing as above." Adding a postscript, Horace P Smart, president and general manager, says: "I have been using your engines since 1869 in Studebaker Bros., South Bend, Ind., first. I have bought over a dozen from you since. All your engines in this section are giving good satisfaction."

Electrical Patents.

Issued June 12, 1888.

384,271. Electric Pendulum Clock. Albert L. Parcelle, New York, N. Y.

384,289. Automatic Switch for Secondary Batteries. John S. Sellon, Hatton Gardens, County of Middlesex, England.

The last claim reads: "The combination of a dynamo-electric machine and a secondary battery in one circuit, an artificial resistance, and an automatic electro-magnetic circuit changer operated by variations in the current flowing in said circuit to divide said circuit into two independent closed circuits—one containing the dynamo and resistance and the other the battery."

384,320. Printing Telegraph. Edward J. Mallett, Bay Side, N. Y.

384,321. Polarized Electro-Magnet. Edward J. Mallett, Bay Side, N. Y.

384,322. Printing Telegraph. Edward J. Mallett, Bay Side, N. Y.

384,323. Automatic Pole-changer. Edward J. Mallett, New York, N. Y.

384,324. Automatic Telegraphy. Edward J. Mallett, New York, N. Y.

384,325. Automatic Telegraphy. Edward J. Mallett, New York, N. Y.

384,326. Automatic Pole Changer. Edward J. Mallett, New York, N. Y.

384,350. Combined Telegraph Key and Sounder. John Doggett, Plain City, O.

384,384. Metallic Crest Tile Lightning Rod. Clark B. Nelson, Crawfordsville, Ind.

384,404. Machine for Covering or Insulating Wire. Joseph D. Thomas, South Framingham, Mass.

The first claim is given: "In a wire covering machine, feeding rollers having their grasping surface formed of vulcanized rubber grooved, and thus adapted to grasp the covered wire with a firm elastic pressure without injuring the coatings thereof."

384,430. Electrical Annunciator. Hiram S. Downerd, Zanesville, O.

384,440. Electric Circuit Controller. Otto F. Greim, Newark, N. J.

The object of the invention is to provide a circuit-controlling device which will, by a positive automatic movement of the contact piece, either make or break the connections as desired, with absolute certainty and quickly, thereby preventing the burning or oxydizing of the contact points.

Claim 5 follows: "In a circuit controlling device the combination, with the base and the key pivoted thereon, of a movable contact piece surrounding the axis of the key and movable independently thereof, a pivoted lever, a spring connecting the lever and the contact piece, and a crank pin operated by the key for moving said lever in one direction or the opposite, thereby changing the direction of pull exerted by the spring upon the contact piece."

384,447. Regulating Commutator for Secondary Batteries. Edmond Julien, Brussels, Belgium.

384,455. Printing Telegraph Receiver. Henry Mahnken, New York, N. Y.

384,472. Electric Winding Attachment for Clocks. Andrew J. Reams, Augusta, Kan.

384,476. Police Electric Signal System. Charles E. Scribner, Chicago, Ill.

The invention consists in providing at each station in connection with the district box a branch circuit, which may be closed to ground, and a switch in connection with the answer-back signal of the district box, and at the central station two relays—one in each branch or side of the metallic circuit to operate the register included in a local circuit connected with the relays.

384,477. Multiple Switch-Board Circuit. Charles E. Scribner, Chicago, Ill.

The invention relates to multiple switch-board systems of a telephone exchange, and its objects are, first, to make both ends of a metallic circuit accessible at one of the switch-boards; second, to enable the operator to connect two such lines in such manner that one annunciator will remain in circuit as a clearing-out annunciator; third, to enable the operator at one of the boards to connect one end of a metallic circuit with the switch of a ground circuit, so that the annunciator of the metallic circuit will remain in circuit as a clearing-out annunciator; fourth, to enable an operator at any one of the boards to test to determine whether any line wanted is in use or connected at any other of the boards; and, fifth, to bring the key-board or table apparatus at each board within as small a compass as possible, and make the same more simple and efficient.

Claim 3 reads: "In a metallic circuit telephone system, the combination, with one end of the circuit connected through a switch upon the switch-board, of the other end of the same circuit connected to a flexible cord and plug upon the same switch board, whereby connections may be made with either or both ends of the said metallic circuit upon the same board."

384,478. Incandescent Lamp Socket. John Spink and Charles Gauzentes, Bradford, County of York, England.

384,505. Car Truck. William J. Brewer, London, County of Middlesex, England.

384,561. Electric Comb. Carl Busch, Chicago, Ill.

The object of the invention is to construct a comb for toilet purposes capable of giving an electric action accompanied with an agreeable sensation of electrical action, and thereby productive of beneficial effects to the user, independent of any of the medical properties the structure may have.

384,562. Electric Railway. G. Herbert Condict, Philadelphia, Pa.

Claim 1 follows: "The combination of a car track with battery slide carriage movable transversely across the line of said track, a battery supporting slide having a rack, a pinion on said battery slide carriage, and suitable means to rotate the pinion to propel the slide from the carriage into the car, or vice versa."

384,570. Electric Circuit Closing Device. Milton W. Grovesteen and Frederick G. Jahn, New York, N. Y.

The invention relates to the construction of devices for communicating motion through the walls of a chamber, reservoir, or tube designed to contain any gas or fluid.

Claim 8 follows: "In a circuit closing device, a vane or valve having wings folding in a given direction and a circuit closing arm or points actuated by means of the vane."

384,576. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The invention relates to the arrangement of the storage batteries under the seats in a peculiar manner, whereby they may be easily inserted or removed.

Claims 1 and 14 are given: "An electric car having its front or operator's platform of a width equal to or substantially equal to the distance between the seats, and having the front ends of the compartments under the seats made open for the insertion of batteries within said compartments from the front end of the car."

"14. An electric car having a compartment exterior to the passenger compartment, and having an opening extending to the outside of the car, a removable door or cover to the opening to said compartment, two or more battery cells, and a removable slide or support for said batteries, whereby said slide or support, with its batteries, may be simultaneously inserted or removed from the compartment through the doorway to the outside of the car."

384,580. Apparatus for Electric Traction. Edmond Julien, Brussels, Belgium.

384,581. Electric Railway Car. Edmond Julien, Brussels, Belgium.

384,594. System of Electric Locomotion. Henry A. Seymour, Washington, D. C.

The first claim follows: "In an electric railway system, the combination, with a line conductor, of a rigid frame, contact rollers journaled on said frame and bearing upon opposite sides of the line conductor, and a single weight carried by the frame and adapted to hold both rollers in contact with the line conductor."

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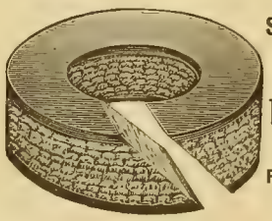

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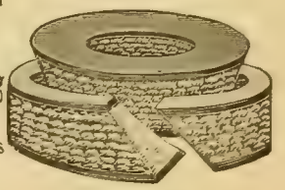

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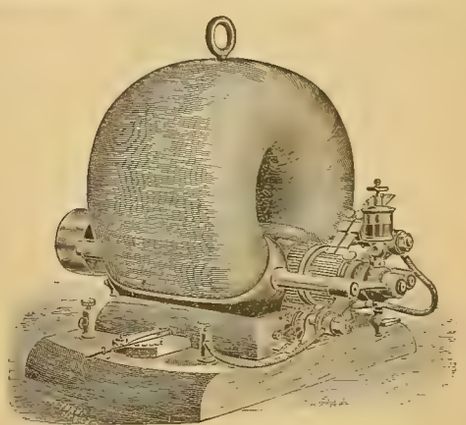

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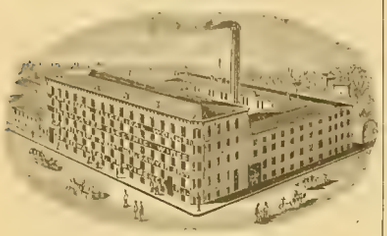

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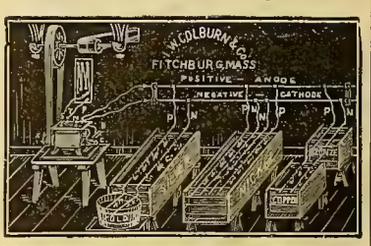

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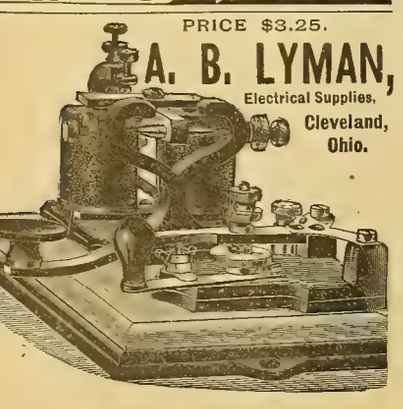

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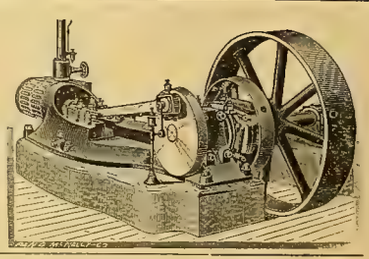

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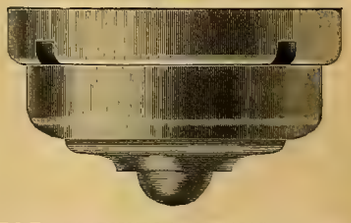

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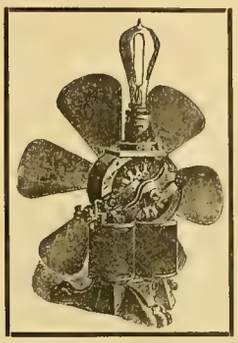

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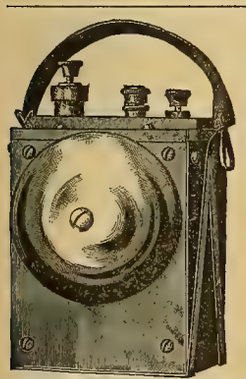

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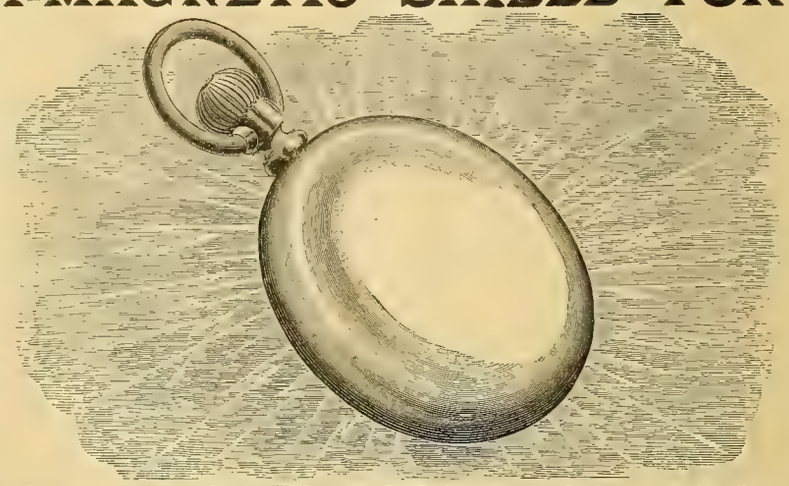

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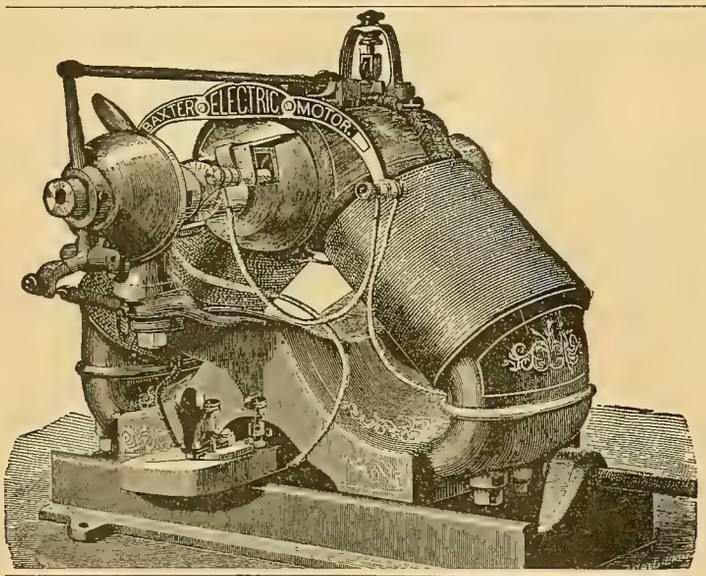

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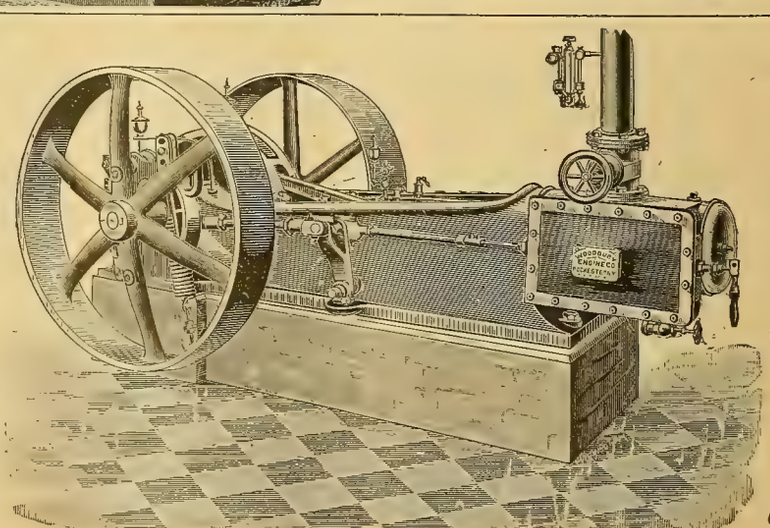

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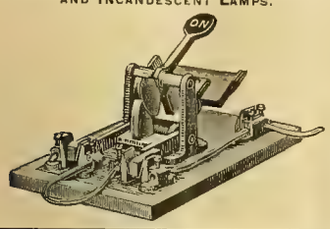

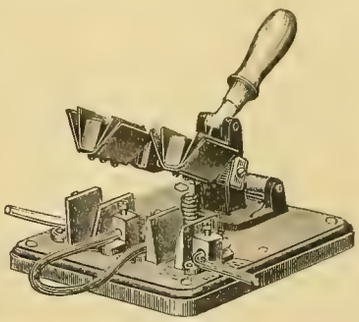

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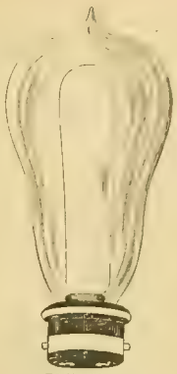
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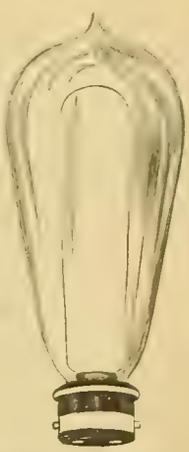
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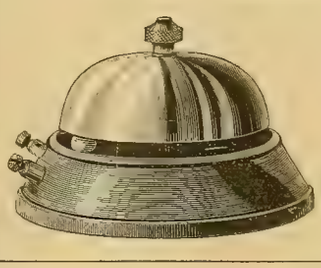

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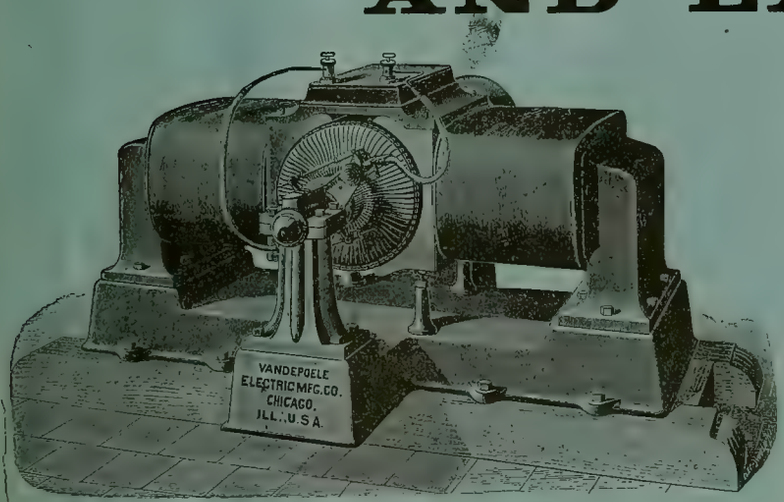

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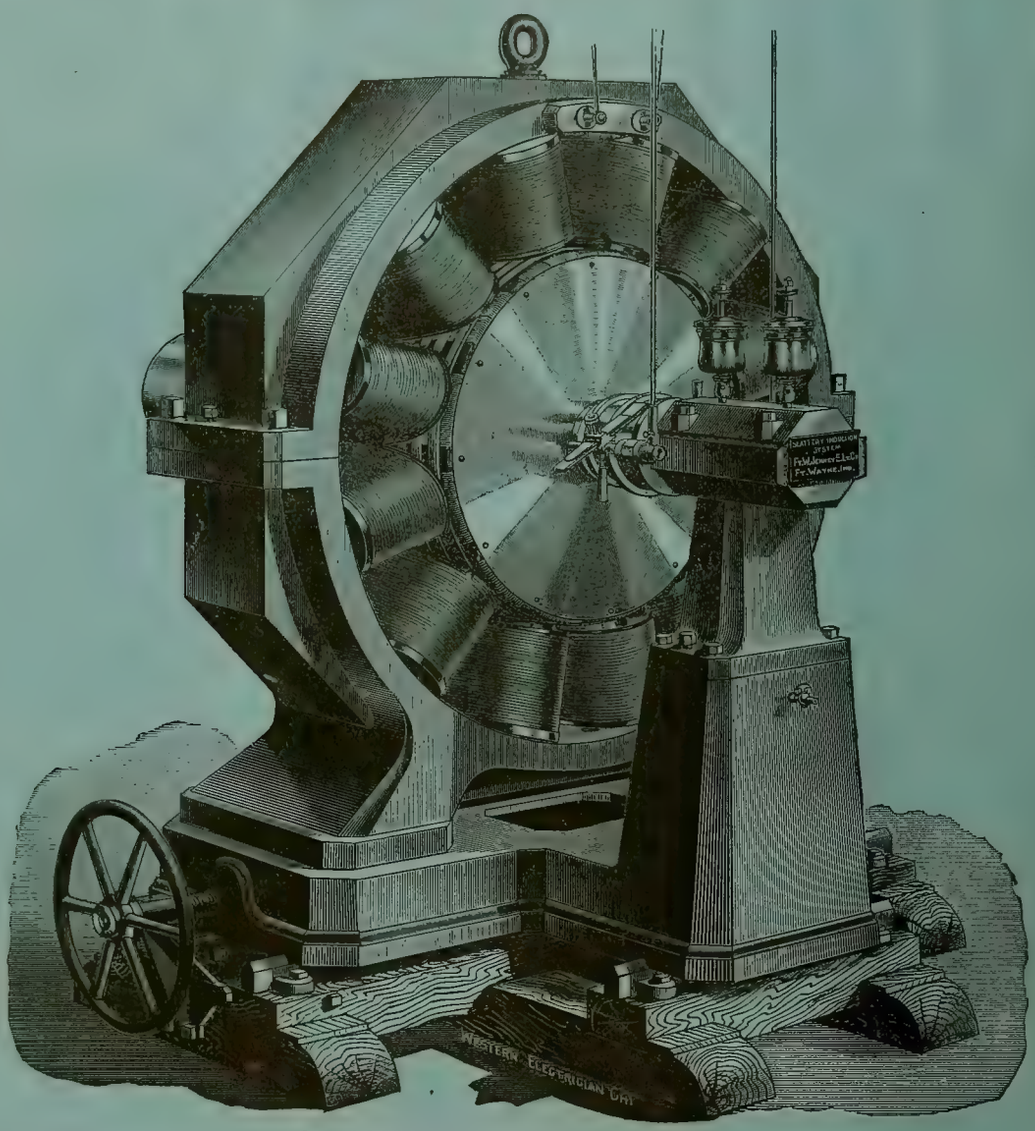

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Branch Offices: { New York, Telephone Building, Cortlandt Street, G. L. Wiley Manager. Chicago, 139 East Madison Street, F. E. Degenhardt, Manager.

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For Telegraph, Telephone, Electric Light and Power; Underground, Submarine and Aerial.

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Weatherproof Line Wire, Underwriters', Annunciator and Office Wire,

Five Years of Uniform Success Enable us to Guarantee our Cables.

DAY'S KERITE INSULATION.

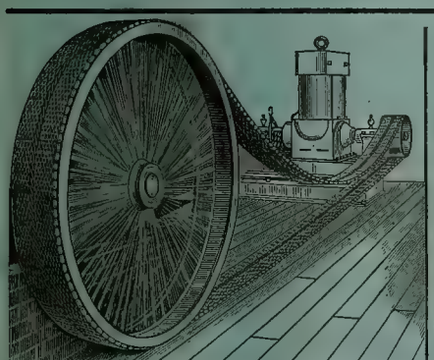
The acknowledged Standard for durable and high Insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

All Sizes *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

CLARK B. HOTCHKISS, Gen'l Mgr., - 16 Dey St., NEW YORK.



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Leather Link Belt Co.

SPECIAL

DYNAMO BELT!

CHAS. A. SCHIEREN & CO.

Manufacturers and Sole Agents,

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DUST AND BUG PROOF BELLS

ELECTRIC DOOR OPENERS,

Electrical House Furnishing

APPARATUS OF EVERY DESCRIPTION.

HAZAZER & STANLEY,

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—MANUFACTURERS OF—

BITITE and TRINIDAD

INSULATED WIRES AND CABLES.

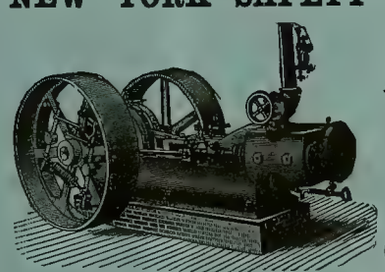
Bitite Wires for Use Underground, in Plaster, Damp Places, Etc., Etc.

TRINIDAD WIRES for Line Work in place of Underwriters.

ELECTRIC LIGHT WIRES of all sizes a SPECIALTY

NEW YORK SAFETY STEAM POWER CO.,

Builders of High Grade Self-Contained



Automatic Cut-Off Engines,

SPECIALLY ADAPTED FOR RUNNING

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And other duty requiring close regulation of speed.

WESTERN OFFICE AND WAREROOMS:

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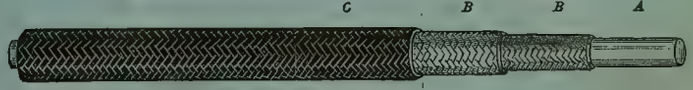
Sole Manufacturers of COWLES' PATENTED

Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

C B B A



CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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FACTORIES: ANSONIA, CONN.

DANIEL W. MARMON, President.
ADDISON H. NORDYKE, Vice-President.

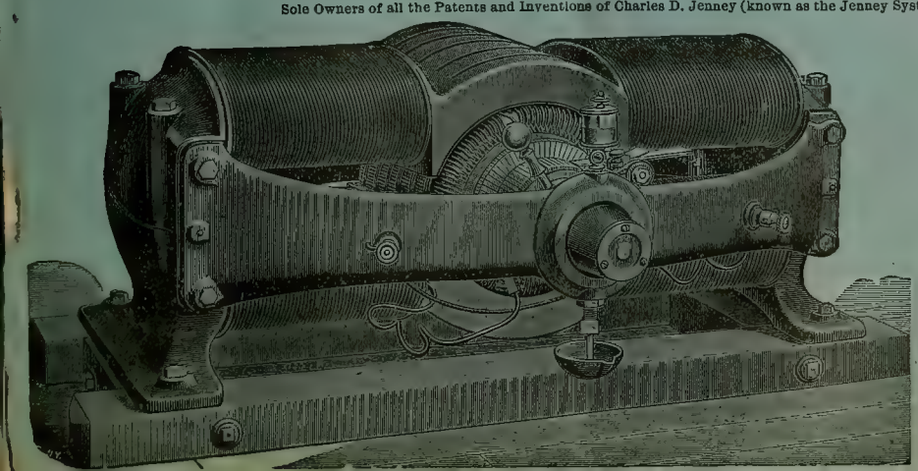
CHARLES D. JENNEY, Electrician.

BRAINARD ROBISON, Secretary.
AMOS K. HOLLOWELL, Treasurer

JENNEY ELECTRIC COMPANY,

INDIANAPOLIS, INDIANA.

Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp and Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

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PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

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This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

☞ SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM. ☜

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178 DEVONSHIRE STREET, BOSTON.

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ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

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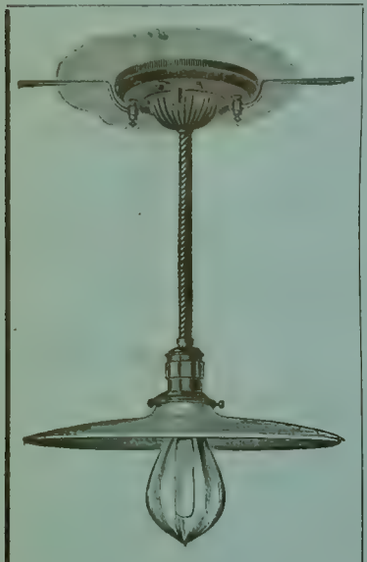


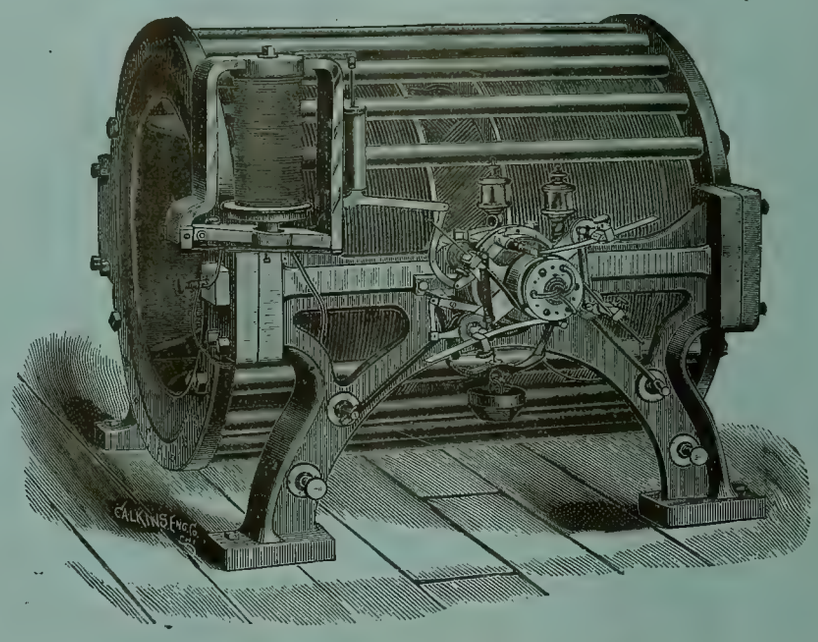
SERIES LAMPS

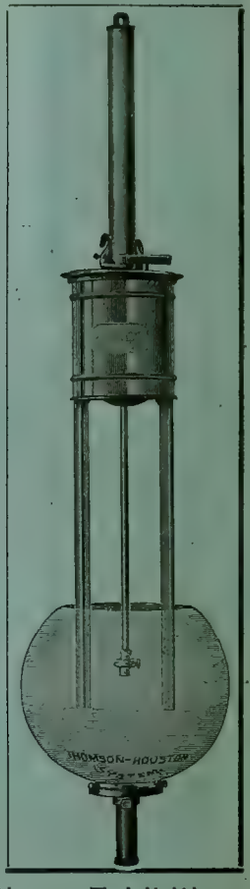
—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.



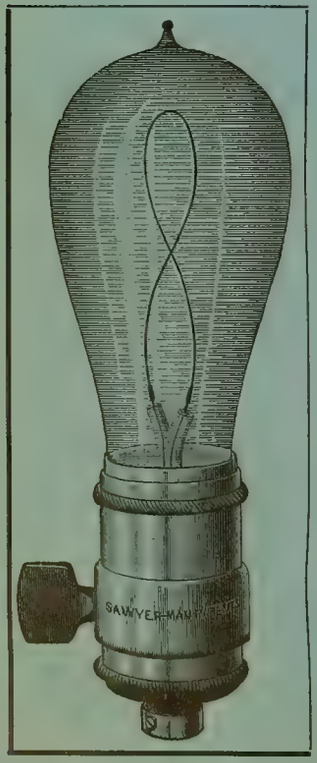


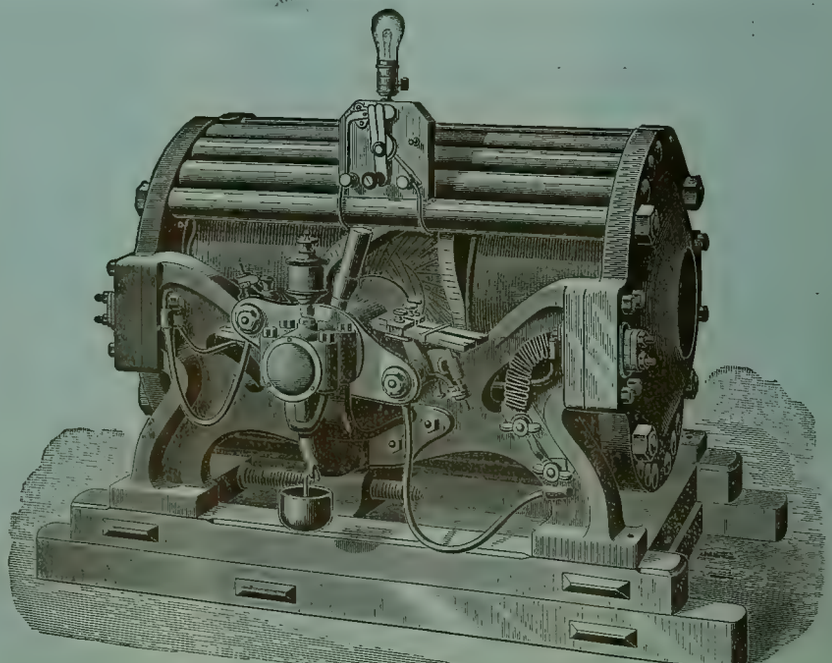
This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.





SELF GOVERNING ELECTRIC MOTORS,

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

The Edison Direct System of Central Station

ELECTRICAL DISTRIBUTION.

1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

THOMAS ALVA EDISON.

Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 150,000 Lamps.
CHICAGO CO. Capital, $750,000, 1 Station; Capacity 40,000 Lamps.
BOSTON CO. Capital, $650,000, 2 Stations; Capacity, 50,000 Lamps.
PHILADELPHIA CO. Capital, $1,000,000, 1 Station; Capacity, 50,000 Lamps.

It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

WRITE FOR PAMPHLET ON THE FIVE HEADS

PATENTS, INVESTMENTS, FUTILITY OF GUARANTEES, DANGER AND MORAL.

For information relative to Central Station Business, apply to the

Edison Electric Light Co.,

16 & 18 BROAD STREET, NEW YORK.

U. S. LAMP.

GRAND OPERA HOUSE

MINNEAPOLIS.

610 U. S. 16 Candle Lamps, 53 Indicated HORSE POWER.
348 Edison 16 " " 54 " "

CONSEQUENTLY, THE

EDISON PLANT WAS REJECTED AND PUT OUT,

AND UNITED STATES PUT IN.

U. S. 610 Lamps, 53 H. P., equals $11\frac{60}{100}$ per H. P.
Edison 348 Lamps, 54 H. P., equals $6\frac{44}{100}$ per H. P.

ABOVE FROM ACCURATE TESTS. NO COMMENTS FOR PARTICULARS, APPLY TO

THE U. S. ELECTRIC LIGHTING CO.,

C. C. WARREN, Manager. 219 LA SALLE ST., CHICAGO.

EDISON VS. THE UNITED STATES ELECTRIC LIGHTING CO.

"WHOM THE GODS WOULD DESTROY,
THEY FIRST MAKE MAD."

The anger of the Edison Company, since being beaten at law, is forcibly manifested by a "Confidential Circular to Edison Agents" over the signature of E. H. Johnson, President of the Edison Electric Light Company, New York, containing alleged explanations as to why Edison was beaten at law, in which the dignified (!) president delivers himself of his wrath in a tirade of abuse, libelous and personal, against a most humble and unimportant individual, and produces the first "patch" for the "collapsed airship" as predicted in "The Edison Boomerang" Circular.

As the general public may desire to see this confidential circular, a large edition has been provided, and will be furnished in unlimited quantities, postage prepaid, upon application to

THE UNITED STATES ELECTRIC LIGHTING CO., THE ROOKERY CHICAGO.

C. C. WARREN, MANAGER.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

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CONTRACTING ENGINEERS FOR ERECTING COMPLETE STEAM PLANTS FOR

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Electrical Apparatus and Supplies,

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POND ENGINEERING CO.

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Complete Steam Plants

FOR ELECTRIC LIGHT AND POWER.

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LICENSEES OF THE

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OWNERS OF THE SAWYER-MAN PATENTS.

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SAWYER-MAN ELECTRIC COMPANY. SAWYER-MAN SYSTEM. TRADE MARK

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Estimates Furnished for the Thomson-Houston System of Arc Lighting.

The DYNAMO of this Company is AUTOMATIC in its regulation, and will maintain a UNIFORM LIGHT, with ALL or ANY PORTION of the lights in Circuit. Our LAMP will NOT BLACKEN and will MAINTAIN its CANDLE POWER during its Guaranteed Life.

NON-MAGNETIC WATCHES

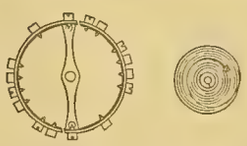
CONTAINING

PAILLARD'S PATENT

Compensation Balance and Hair-spring,

WHICH ARE

Uninfluenced BY Magnetism.



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Adjusted TO Temperature.

These watches have been thoroughly tested and have received the unqualified indorsement of Thos. A. Edison, Elihu Thomson, N. S. Possons, F. B. Badt, Edwin Houston, and a large number of Electricians who have examined and tested them.

These watches are made in all sizes, Hunting and Open Face, and cased in Gold, Gold Filled, and Silver Cases, and cost no more than other makes of same quality without the Non-Magnetic feature.

They are especially adapted to the uses of

ELECTRICIANS AND WORKERS AROUND DYNAMOS,

and for durability, fine workmanship, and accuracy of performance are unsurpassed.

FOR SALE BY ALL FIRST-CLASS JEWELERS.

High Insulation

In order to meet the constantly increasing demands for

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THE BISHOP GUTTA-PERCHA CO.

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FOR MAKING THE CELEBRATED

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Subaqueous, Subterranean and Aerial Cables.

Also, special wires for Leading-in Wires, Wiring Vessels, Engine Rooms, Cellars, Tunnels or other wet places, all having

SUPERIOR INSULATION

And warranted to give good satisfaction at fair prices.

If Underwriters' is good enough, don't send for our samples and prices.

HENRY A. REED, Manager.

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Use Marks' Compound Wire for Battery Coppers.

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GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

GRIMSHAW

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Have stood the test for years, both underground and overhead.

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HOW IT IS MADE AND HOW TO USE IT.

A complete Description of the Various Parts of the Machine, and how to take care of it. With other valuable Electrical Information for the use of those having charge of Electric Lighting Apparatus. Fully Illustrated, with many new Plates and Cuts.

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AND A FULL LINE OF

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N. B.—When applying for Catalogues, please state whether "Electric Bell" or "General Supply" Catalogue is wanted, and if in the trade inclose business card for discounts.

114 South Second Street. PHILADELPHIA, PA.

DAFT COMPANY NOT SELLING OUT!

FAR FROM IT!

THE DAFT ELECTRIC LIGHT COMPANY

Announce that there is ABSOLUTELY NO TRUTH in the rumor that their business is about to change hands, and that the Thomson-Houston Co. are the parties to profit by the change. The business of the Daft Company is MUCH TOO BRISK to admit a thought of selling out to the Thomson-Houston Co. or any other concern. True: the Daft Company are making a change. They have just moved into larger premises thoroughly well fitted to meet the demands of their growing trade.

The new Daft Factory is situated at Marion, N. J., on the Pennsylvania Railroad, a few minutes from New York. IT IS THE LARGEST PLANT IN THE WORLD devoted exclusively to the manufacture of ELECTRIC POWER MACHINERY. Ample facilities are provided for turning out generators and stationary motors of all sizes, and for building and equipping Electric Railways on any desired plan at the shortest notice.

The Daft Company propose as heretofore TO MANAGE THEIR OWN BUSINESS and to hold their own among all competitors.

Motors from One-eighth to 100 Horse Power.
Motors and Electrical Work for Street Railway Service a Specialty.

Generators from 3 to 1000 Horse Power.
Heavy Motors for Rapid Transit Railroads from 10 to 200 Horse Power.

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OFFICES: 115 BROADWAY, NEW YORK. **FACTORIES: MARION, NEW JERSEY.**

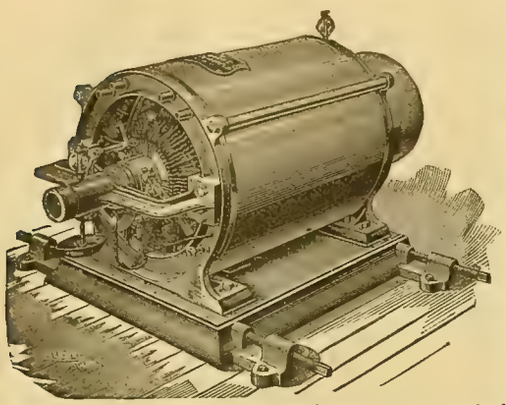
Heisler Electric Light Co.

809-817 S. 7th Street, ST. LOUIS, MO.

MANUFACTURERS OF

The Heisler Patent Incandescent Electric Light System.

The only and original Alternating Current Long Distance Single Wire Incandescent.



We have built 24 Central Station Incandescent Plants within one year, all of which are on a paying basis.

This System combines successfully the illumination of the streets with a general supply of light for stores and houses.

Any desired distance can be reached at small cost; No. 8 American Gauge Copper Wire being used for the outside line, No. 11 for indoors, for any number of lights of any size from 20 to 200 c. p. located anywhere on the line. A perfect automatic regulation adjusts for every variation of the load from the full capacity to one single light. We do not need transformers, distributors, safety catches, resistance boxes or any other electrical contrivance for distribution or safety.

Special attention is called to the superior advantage of this system for economical management. To its flexibility, no mathematical calculation being required for wiring or alterations of circuits. To its production of nearly double the candle power to the H. P., as compared with any other system.

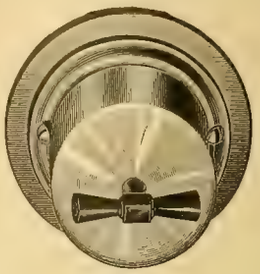
We can furnish substantial proof that our system is a successful competitor against all present methods of illumination.

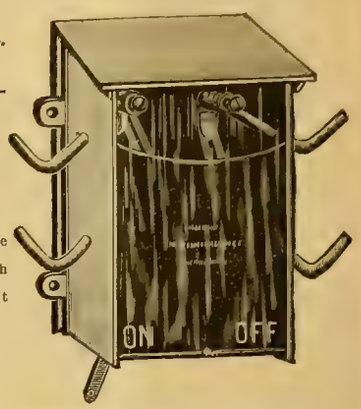
Forest City Electric Works,

Manufacturers of CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.





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W. B. CLEVELAND, Proprietor, 183 SENECA STREET, CLEVELAND, O

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Agents in all Cities. Send for Trial Belt.

Our Belts are the strongest, most even and perfect Electric Belts made.

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ANNUNCIATORS, MAGNETO BELLS, BATTERIES, ETC.

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Single Valve and Corliss Valve

ENGINES.

SELF CONTAINED AND SINGLE CRANK

ENGINES

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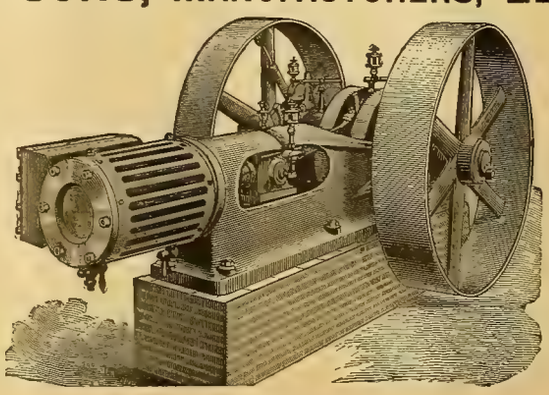


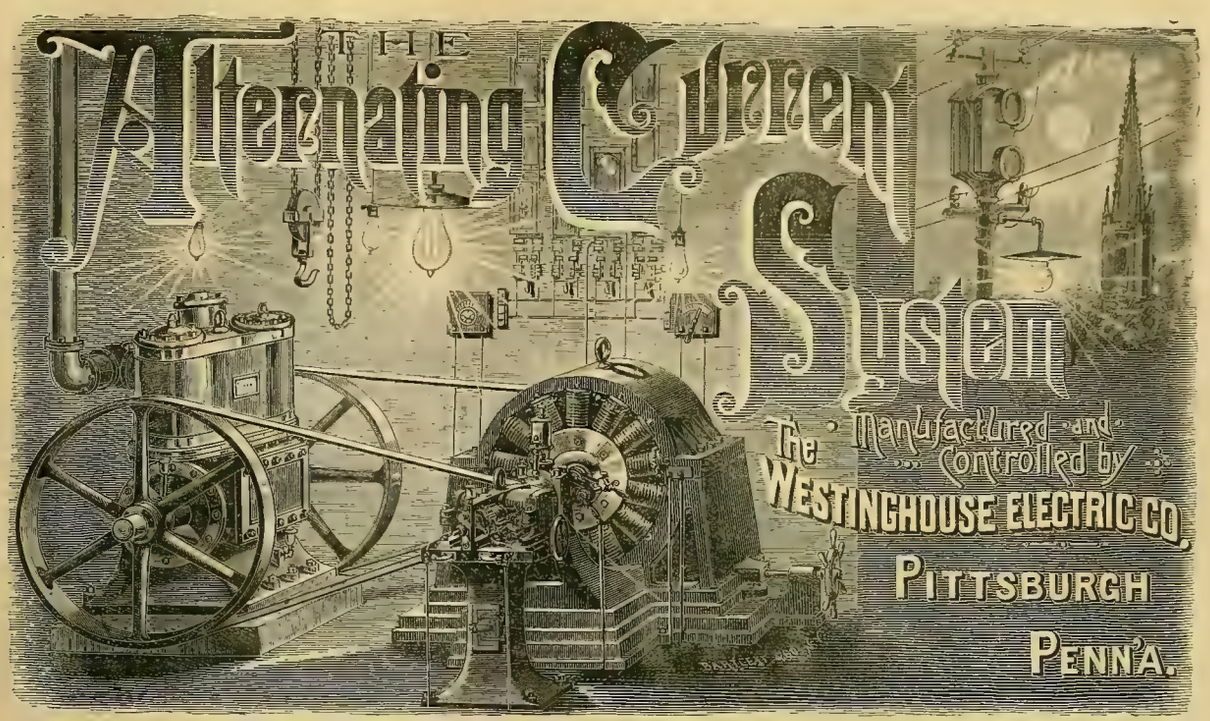
WESTERN DEPARTMENT:

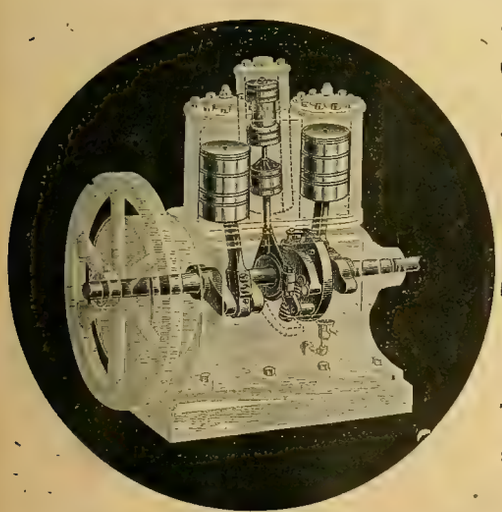
No. 10 S. Canal St.

CHICAGO.

H. S. WALKER, MANAGER.

TELEPHONE 4024.





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SHAFTING { Costs to Purchase / Costs to Maintain / Costs to Lubricate / Costs to Drive } VERSUS THE **Westinghouse ENGINE.**

Independent Engines convert their whole power into merchantable product.

Take the Engine to the Work, not the Work to the Engine.

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ELECTRICAL SUPPLIES
For the Telegraph, Telephone and Electric Light.

Hotel and House Annunciators, Burglar Alarms, Fire Alarms, Electric Gas Lighting, Speaking Tubes, Elevator Annunciators, Batteries, Push Buttons, Electric Pens, Telegraph Learners' Instruments, Medical Batteries, Linemen's Tools, Bell Hangers' Supplies, Railway Velocipedes, Cars, Etc.

WESTERN AGENTS THE OKONITE CO., and the Return Call System of Hotel Annunciators. Fire Alarms for Cities and Towns. We own the Franchises of the Western States and Territories for the

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and are prepared to give franchises and construct plants on reasonable terms.

☞Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.

The Empire City Electric Co.

15 DEY STREET,
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Manufacturers and Dealers

IN ALL KINDS OF

ELECTRICAL SUPPLIES.

"WHERE TO BUY"

Read the following and be no longer in Doubt.

Annunciators, Bells, Etc.

Orders for Annunciators, Bells, Pushes, Pulls and Electric Gas Lighting Material promptly filled.

Western Electric Walnut Box Bell

The best bell for the money in the market. Sample mailed to any part of the United States on receipt of seventy-five cents.

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We call particular attention to our Speaking Tube Telephone System, Watchman's Electric Clock and Automatic Mercurial Fire Alarm for Hotels, Office Buildings, Stores and Factories.

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We are the largest manufacturers in the country of all kinds of Batteries and Battery Supplies.

Disque LeClanche Batteries.

No other kind of battery and no LeClanche battery, except of our manufacture, has shown a record for length of satisfactory service equal to ours.

A correspondent writes us:

"Four cells of your LeClanche Battery have been operating the 250 No. Annunciator at the Lindell Hotel (St. Louis) for **over three years,** giving the very best of satisfaction, and to-day are, to all appearance, just as good as new."

Morse Instruments.

We call particular attention to our improved forms of Morse Instruments. The changes are all in the direction of greater simplicity and cheapness.

PATTERSON CABLES.

These Cables have an unequaled record for telegraph, telephone and electric light use, overhead, under ground and under water, owing to their **permanence, high insulation and low inductive capacity.**

INSULATED WIRES.

We manufacture all kinds of Office, Annunciator and Magnet Wires and Insulated Cordage. We guarantee a conductivity of not less than 97 per cent. of the conductivity of pure copper for all our copper wire. Our largely increased facilities enable us to fill orders for goods in this line promptly and with the best quality of material.

Electric Lighting Apparatus.

Over 4000 of our arc lights are in use and give satisfaction to the users. Our system of lighting is unexcelled in the perfection of its automatic regulation, the steadiness, brilliancy and color of the light produced and the efficiency of the apparatus. We furnish dynamos to give any required current. The superior efficiency of our dynamos renders them advantageous for use in charging storage batteries and for generating current for electric motors. We make Arc Lamps suited to burn on any arc light current.

Line Wire and Supplies.

We are the exclusive agents in the West of Washburn & Moen Mfg. Co.'s Galvanized Iron and Hard Drawn Copper Telegraph and Telephone Wire. The reputation of this make of wire stands deservedly high, and is a guaranty that what we furnish in this line is of the best quality. We furnish only the best material in pins, brackets and other line supplies.

Telephonic Apparatus.

We furnish licensees of the American Bell Telephone Co. with Multiple and Standard Switch-Boards, Magneto Bells and all other Telephone Apparatus.

Builders' & Repairers' Tools.

In manufacturing Bars, Clamps, Climbers, Pulleys, Splicing Clamps, Reels, Tool Belts, Body and Climber Straps, and other Tools, great pains are taken to use only the very best materials and to combine the most recent improvements.

Testing Apparatus.

We manufacture a complete line of Testing Instruments, and call particular attention to the Warner Testing Battery, the Combination Bridge Rheostat and Galvanometer, and Rudd's Device for Testing Arc Light Circuits.

District Telegraph Apparatus.

The Field and Firman four-call box and eleven-call box with answer-back signal are the best in the market. The Field and Firman patents cover the return signal and multiple call features of these boxes, and we warn users against infringements.

WESTERN ELECTRIC CO.,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY

Vol. II. CHICAGO, JUNE 30, 1888. No. 26.

Special Magneto Bell.

The accompanying cut shows a special magneto bell made by the Railway Telegraph Supply company, of Chicago. It has been designed especially for the use of electric light, telegraph and telephone companies, and for all wishing to test circuits of any kind. It is of high efficiency and is capable of ringing through large resistance. It is small and compact, as the cut indicates. It is so arranged with switches that it can be used on alternating or continuous current and in connection with a galvanometer.

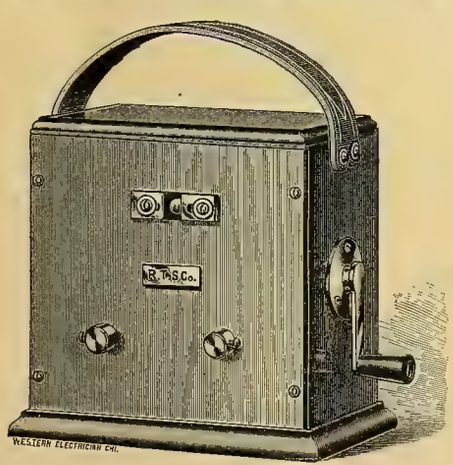
Railroad Telegraphers' Convention.

The Grand Division of the Order of Railroad Telegraphers began its third annual session in Indianapolis last week. The opening exercises took place at Tomlinson Hall, Wednesday, June 20th, at 2 o'clock p. m.

Rev. M. L. Haines, of this city, delivered an invocation. Rev. O. C. McCulloch, of this city, delivered an address of welcome, which was responded to by Hon. G. B. Solders, of Cleveland, Ohio. Past Grand Telegrapher P. W. McAllister also welcomed the delegates, after which A. D. Thurston, Grand Chief Telegrapher, delivered an address. He said at the beginning the O. R. T. had been opposed by many railroad companies, but now they were satisfied it was an order not calculated to work injury to them, but rather to improve that branch of the service. They were now aiding the order. After Mr. Thurston came Assistant Grand Chief Telegrapher C. J. Coombs, of Newton, Kansas, who delivered a brief address showing the growth of the order, and expressing confidence in its future prosperity. Following is list of delegates:

California: I. C. Parish, Barstow; Colorado: Wm. R. Freeman, Denver; J. M. Rector, Los Animos; F. M. Moore, Pueblo; Dakota: W. E. Van Amber, Halton; Georgia, P. H. Sellars, Atlanta; Illinois: J. A. Bardeaux, C. A. Sherman, J. H. Meyers, C. B. Hawley, L. E. Sessions, R. W. Sears, R. L. Nellis, Chicago; W. A. Bryan, Peoria; C. E. Hallis, Chrisman; Nebraska: G. B. Riker, Covington; J. E. Morris, Plattsmouth; H. Compton, Omaha; W. G. Cone, Lincoln; Indiana: T. M. Pierson, W. A. Harvey, O. A. Soaper, O. R. Brown, H. G. Crowe, I. S. Pierce, Indianapolis; L. H. Clarkson, Valparaiso; T. B. Shirley, Galveston; T. G. Gallagher, Covington; Geo. T. Sweeney, O. N. Tomlinson, Terre Haute; H. B. Brown, Russellville; J. F. Parish, T. E. Lewis, Roachedale; Iowa: A. D. Thurston, A. A. Byerly, H. G. Adams, S. A. Wagner, S. O. Fox, La Porte City; J. E. Rice, W. F. Doran, J. J. McElrath, Cedar Rapids; E. B. Wurzbacker, Carroll; E. McDonald, Sioux City; C. W. Holmes, Oasis; I. B. Haymond, Northwood; A. G. Kamm, W. G. Russell, Burlington; A. B. Stilwell, F. L. Herling, Dubuque; J. W. Lashelle, Iowa City; Kansas: A. J. Applegate, Wichita; C. E. Adams and H. E. Wasson, Leavenworth; W. C. Carson, H. C. Kist, C. J. Coombs and H. C. Marshall, Newton; Henry Smith, J. D. Sutherland, Atchison; Kentucky, N. H. Kirch, T. W. Hutchinson, W. W. Ware, of Lexington; Maryland: J. B. Finnan and W. G. Wheeler, of Baltimore; Michigan, Miss M. E. Dunwoodie, H. B. Markle, and J. Matson, Detroit; C. H. Gates, Jackson; P. G. Bromley, Tilsonburgh; Minnesota: F. J. Eikan, Perham; J. O. Bell and Miss L. S. Griswold, St. Paul; H. S. Heisler, Duluth; T. S. Wilcox, Kasota; H. W. Brown, Utica; E. A. Hinds, Alexandria; E. S. Tobey, Waseca; P. W. McAllister, and J. J. Barrett, Minneapolis; C. E. Hand, Litchfield; H. Britton, Waseca; A. T. Behnke, New Ulm; Mississippi: M. B. Rice, Flora; Missouri: F. M. Peare, St. Joseph; J. L. Code and J. N. Ashley, Kansas City; D. O. Freeman, St Joseph; A. C. Nye, Springfield; Montana: J. E. Murphy and E. E. Quackenboss, Terry; New Mexico: W. S. Bouton, Las Vegas; New York: E. E. Barnes and J. T. Connors, Albany; Miss Ella R. Bixby, Canton; E. J. Blakesly, Buffalo; H. B. Buddengberg, Jamestown; Ohio: T. C. Eddy, W. L. Hayne, and A. J. Hall, of Cleveland; D. C. Larcomb, H. S. Lambdin and J. Hargrove, Columbus: H. W. Meader and A. W. Brant, Toledo; J. T. Milton, Navarre; B. F. Hubbs, Middletown; D. V. Ault, Alliance; W. T. Burt, Denison; G. M. Sanderson, Canton; Pennsylvania: C. E. White, Econsburg; T. J. Bradley, Pittsburgh; Tennessee: R. P. Wall, Memphis; Texas: Miss Lillie Thornhill and G. T. Thornhill, Navasota; J. B. Douglas, Denison; R. L. Darling, Dallas; W. B. Mitchell, Killen.

Thursday, was occupied hearing the reports of grand officers. Grand Chief Telegrapher Thurston in his annual address states: The order was organized June 9, 1886, at Cedar Rapids, Iowa. There were 75 members to start with. The second annual meeting, held at Chicago



last year, showed that the order had grown to 2,500 members, and now there are 90 local divisions with a membership of between 9,000 and 10,000 and growing rapidly.

The Grand Secretary, S. O. Fox, reports the order in a flourishing condition, with over $3,000 in treasury and out of debt. In the last year, something over $3,000 has been expended for benevolent purposes among members, in addition to the insurance branch. The committees on credentials and permanent organization made their reports, which were adopted. The judiciary committee consists of J. A. Bordeaux, chairman; J. B. Finnal, C. E. Adams, T. C. Eddy, O. H. Wilson.

On Friday, numerous resolutions were presented and referred to the proper committees, which have a large amount of work before them. A resolution was offered, favoring the establishment of postal telegraphy, but this was voted down by a good majority.

Saturday, as a number of delegates were obliged to return to their homes, was occupied in electing officers for ensuing year with the following result:

Grand Chief Telegrapher, A. D. Thurston, La Porte City, Iowa; Assistant Grand Chief, A. Johnson, Louisville, Ky.; Grand Secretary and Treasurer, S. O. Fox, La Porte City, Iowa; Grand Senior Telegrapher, F. M. Moore, Pueblo, Colorado; Grand Junior Telegrapher, T. C. Eddy, Cleveland, Ohio; Grand Inside Sentinel, E. E. Barnes, Albany, N. Y.; Grand Outside Sentinel, J. E. Gibson, Meridian, Miss. To fill vacancies, J. A. Bordeaux and J. O. Bell were elected members of executive committee.

It was decided to hold next annual meeting in Cleveland, O., June, 1889. A resolution was introduced to raise salary of Grand Chief $500 and Grand Secretary and Treasurer $300 a year, but the resolution failed to pass, though a resolution to appropriate the above amounts to those officers for present year was passed.

There is a resolution before the convention, looking to removal of headquarters of Grand officers from La Porte City, Iowa, to Vinton, Ia.

Chicago Electric Club.

The annual meeting of the Chicago Electric club was held Thursday evening, June 21st, with Vice-President Brown in the chair. The regular order of business was suspended.

The secretary read the appended report of the board of managers:

The close of the first year of the existence of the Chicago Electric club finds it in a condition which warrants the management in congratulating the members as well on what has been accomplished as on the prospects of the club.

Much disinterested work has been done by the managers and other members of the club, and it has been with a view of making the work of looking after the interests of the club less burdensome to the succeeding board of managers, as well as having it more efficiently performed, that the retiring board has appointed a custodian on a salary.

While the finances of the club are not just now in as satisfactory a condition as could be desired—as will be shown by the treasurer's statement attached hereto—they are not at all desperate, considering the fact that another quarter's dues will be payable at an increased rate in about two weeks. It has been thought advisable to give members who are interested in the club and receive its benefits an opportunity to subscribe for the further furnishing of our rooms. It seems reasonable to expect that a thousand dollars can be raised in this way, which will leave the club free from indebtedness, and with property to the value of $2,000 on hand.

The value of the papers read before the club and of the discussions following them is sufficient to suggest the expediency of having them printed in pamphlet form, as is done in the Institute of Electrical Engineers.

The social, scientific, and business advantages of the club are such as to insure its continued growth and prosperity, and it is predicted that it will soon be necessary for the club to have a house of its own.

The secretary also read the report of Treasurer Terry, as follows:

I have already given details in previous reports, and will now treat generally. During the past year we have paid obligations as they became due, and, besides, have expended some $1,000 for fixtures and fitting up rooms. Our probable income will be sufficient to pay regular expenses, and it needs the addition of one-third more members—say fifty additional—to enable the club to collect a surplus. At present the finances are low, which is natural at the close of the quarter. On July 1st we shall commence to receive remittances for a new quarter's dues. The club needs only to increase its membership as has been suggested, and keep its dues well collected, to make it financially sound during the coming year.

The polls were then opened for two hours, with Messrs. Haskins and Pratt as tellers, and the regular and only ticket in the field was elected, as follows:

OFFICERS ELECTED FOR 1888-1889.

President.—S. A. Barton.

Vice-Presidents.—1st, C. A. Brown; 2d, J. P. Barrett; 3d, B. E. Sunny; 4th, H. Ward Leonard.

Secretary.—W. A. Kreidler.

Treasurer.—F. S. Terry.

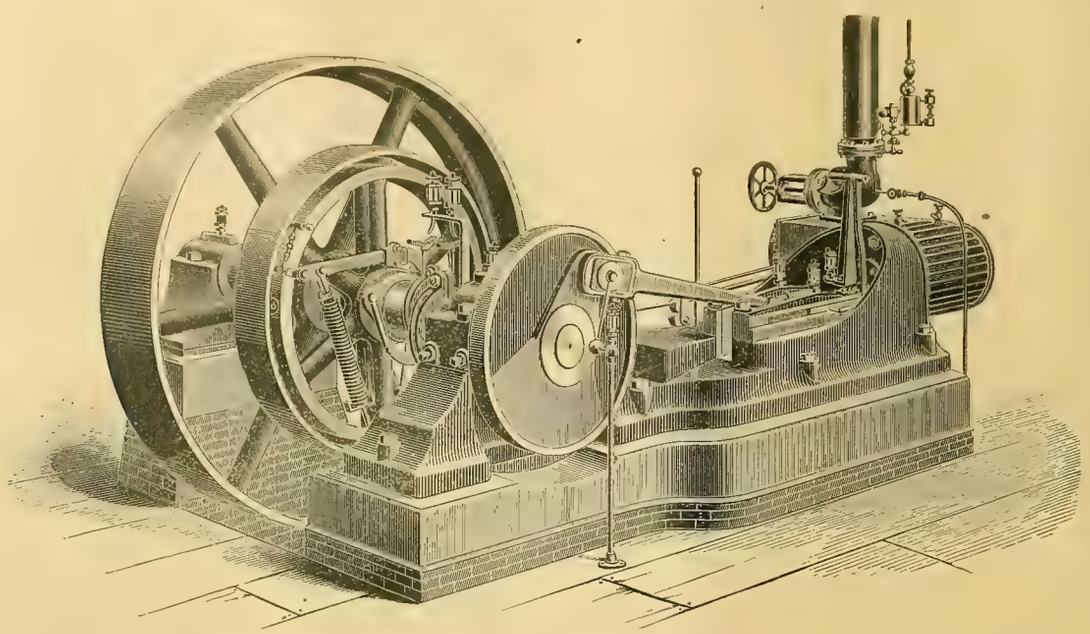
Managers.—C. D. Shain, F. E. Degenhardt, E. B. Chandler, J. H. Reid, Theo. P. Bailey, A. K. Stiles, C. C. Warren, W. J. Buckley, M. A. Knapp, Geo. L. Beetle.

Membership Committee.—C. C. Haskins, J. W. Clark, Geo. Cutter, W. H. McKinlock, F. W. Horne.

The Williams Single Cylinder Automatic Cut-off Engine.

In connection are shown illustrations of the Williams single cylinder automatic cut-off engine, manufactured and sold by Fairbanks, Morse & Co., Chicago, Ill.

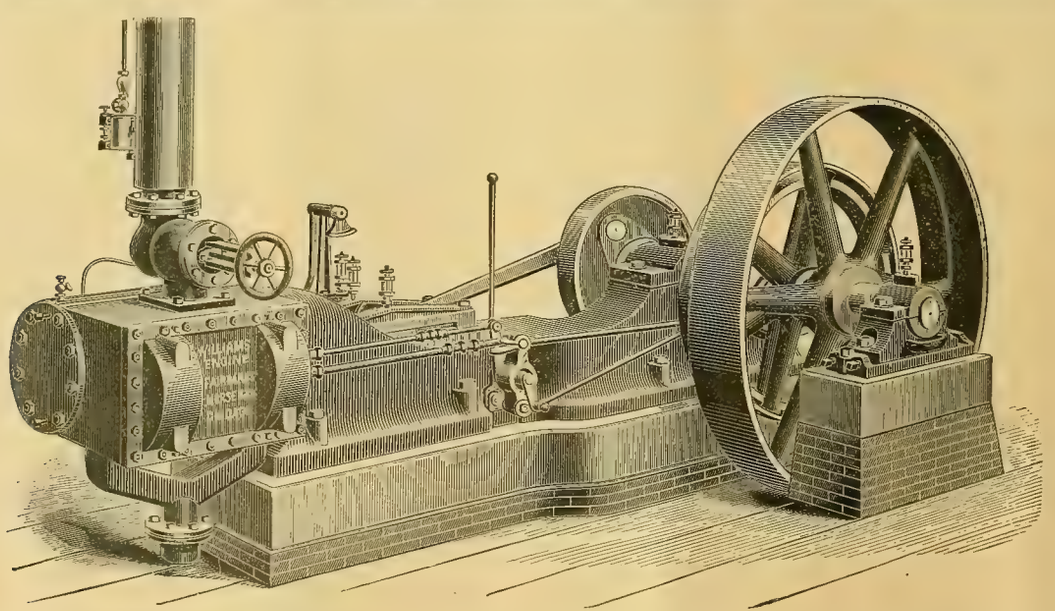
This engine is a new design and has achieved such remarkable results as to attract the attention of leading engineers throughout the country. It is of the high speed class, having shaft, governor and balanced valves, two in number, and directly connected valve gear. The proportions are graceful and all the wearing surfaces very ample and of best material. The distribution of steam and weight forces upon the bearings has been carefully calculated, so that no unnecessary strains shall be brought on any part. Mr. Williams having made a long and exhaustive inquiry into the effects of inertia in the reciprocating parts of steam engines, and having made an instrument for its measurement, has thereby fully prepared himself for this important work, and as a result, produced an engine which runs with remarkable smoothness of action.



One of the most valuable features, and one which is quite novel to engineering practice, is a construction of pressure plates which admits steam on their under sides, counteracting in a large part the pressure on their backs. No injury to the valve faces, therefore, can result from letting the plates down hard upon the valves, and, when so adjusted, the high portions of the faces will wear gradually away under the light pressures brought upon them, and the leakage, if there be any, will cease. When the wear has equaled the amount the plates were let down, the plates will bear wholly on distant ledges at their ends, and the valves move freely under them. This feature furnishes an easy, safe and sure means of keeping the valves tight. These pressure plates do not, therefore, require that refinement of accuracy in fitting and adjusting which has been considered very objectionable to other pressure plate systems.

The cut-off valves have adjusting screws, easy of access, and the matter of adjustment for wear is simple. Any leakage from these valves is excluded from the cylinder at about 5/8 stroke by the main valve, and could not therefore result in any serious harm. The valves being in fact balanced, will wear but slightly, requiring very little attention and never to be replaced by new ones. Another feature of this valve system is of highest importance. The port openings are doubled for admission, cut-off and release. This is one of the reasons for the exceptional economy claimed for these engines. A thorough separation of live steam from exhaust is another essential to economy accomplished by these valves.

Within the casing of the governor is an "inertia wheel" which acts in connection with the ordinary weights and spring forces. This feature is also novel and produces a very admirable effect upon the action of the engine. The inertia wheel neutralizes the effect of the inertia in the governor weights and assists the governor in overcoming the resistance of the cut-off valve. The weight and spring forces are made light, therefore, and the action is free and rapid.



Appended are results of tests made on one of these engines under ordinary working conditions, at B. Lowenstien & Bros'., Memphis, Tenn. :

Date of trial test	January 20th, 1888.
Size of engine	12½ "x 20."
Revolutions per minute	235.
Duration of test	5 hours.
Average indicated horse power	90.
Total coal used	1,870 lbs.
Less 5 per cent refuse	1,777 lbs.
Coal per hour	355 5 lbs.
Coal per indicated horse power per hour	3.95 lbs.
Total water evaporated in 5 hours	13,279 lbs.
Evaporation per hour	2,453 lbs.
6% off for steam pump and leakages	2.306 lbs.
Feed water per indicated horse power per hour used by the engine	25.62 lbs.
Feed water evaporated per lb. coal	6.9 lbs.

During this test there was quite a leak from one of the steam pipes, and the boiler was supplied with water by a steam pump. Besides, the exhaust steam was turned on the heating pipes of the building, which gave at least 1½ lbs. of back pressure.

It will be noticed that the evaporative power of the boilers was low, mainly on account of the inferiority of the coal which was used. With first-class coal the consumption would have been but little over 3 lbs. per indicated horse power per hour.

The test was conducted on the part of Lowenstein & Bro. by Frederick Schlattenberg, chief engineer of U. S. custom house, Memphis, Tenn.

Messrs. Fairbanks, Morse & Co. are building these engines compound condensing also, and the performance justifies the prediction that there will be a large demand for them. The saving in fuel by compounding over single cylinder non-condensing appears to be about 40 per cent.; 2½ lbs. of coal, therefore, per horse power per hour is about what may be expected as the performance of these engines compound condensing.

Electric Storage.

By Philip Atkinson, Ph. D.

Part II.

Plante's Secondary Cell.—This cell was originally constructed with two plates of sheet lead, separated by strips of gutta-percha, one sheet being laid over the other, with two gutta-percha strips between them, and two more laid on the upper sheet, as shown at *A*, Fig. 4. They were then rolled together and clamped, giving them the compact form shown at *B*, a strip of lead being left attached to one corner of each sheet in cutting, by which connection could be made for charging and discharging. The sheets, rolled together in this manner, were placed in a tall jar of glass or ebonite containing water mixed with 10 per cent. of sulphuric acid, the jar being fitted with an ebonite cover, provided with binding screws to which the connecting strips were attached, and also clamps for holding wires to show the heating effects of the discharge.

The next step was the electrical preparation of the plates, which was accomplished by charging them with a battery of two or more cells; one cell being insufficient to overcome the resistance from polarization. The current was continued till the oxygen evolved at the positive pole ceased to combine with the lead, and was given off as gas. The cell was then disconnected from the battery and discharged by making connection between its electrodes and a fresh charge given in reverse order, and continued as before until gas was given off. This process was continued for several months with intervening periods of repose, during which the cell remained charged and the time of charging was increased from a few minutes on the first day to several hours subsequently. In like manner the periods of repose were increased from hours to weeks and months.

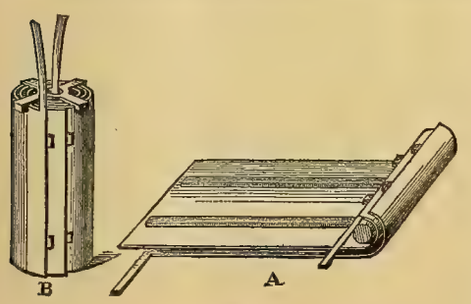


Fig. 4.

Chemical Reaction in the Plante Cell.—To understand the object of this treatment it is necessary to examine the chemical reactions which take place in connection with the electric action. It will be noticed that three distinct periods are required in this process: the period of charging, of repose and of discharging, during each of which a distinct chemical reaction occurs. During the charging, as already stated, peroxide of lead collects on the plate connected with the positive pole, and hydrogen on the one connected with the negative. But at first only a thin film of the peroxide is formed, and a small amount of hydrogen collected, and the absorption of the gases soon ceases. The plates are then discharged, and during the discharge the peroxide, which is insoluble in sulphuric acid, is reduced to monoxide, Pb O, which is immediately reduced to sulphate of lead, Pb S O_4, by the acid present in the solution, while the oxygen atom, taken from the peroxide, unites with the lead on the opposite plate, forming monoxide, which, in turn, is reduced to sulphate.

The result of the first discharge, then, is a thin film of the sulphate on each plate. The plates are then charged in reverse order, and the sulphate on the plate now connected with the positive pole is reduced by the oxygen to peroxide, while that on the opposite plate is reduced by the hydrogen to spongy lead, which adheres to the plate in a finely divided condition. As each subsequent charge, after discharge and reversal, produces the same result, each coating continues to increase in thickness, and the spongy lead affording increased facility for the formation of the peroxide, the chemical reaction proceeds more rapidly.

But the increased thickness of the peroxide soon interposes a strong resistance to this reaction, hence a period of repose previous to the discharge becomes necessary; and during this period local action, as it is called, takes place. This consists in the reduction of the peroxide to sulphate from the reaction of the supporting lead plate; the metallic lead, having a strong affinity for oxygen, the peroxide parts with one atom of its oxygen, which unites with the lead, and the resulting monoxide is immediately reduced to sulphate by the acid.

The chemical reaction of the discharge may now be more fully considered. Its result, as has been shown, is the formation of sulphate of lead on both plates; and this sulphate, lying next to the plates, forms a resistance which impedes local action, which, as shown above, takes place during the period of repose. If the discharge is rapid, there occurs not only a reduction of peroxide to sulphate on the one plate, but also a reduction of a portion of the sulphate on the other plate to peroxide through an excess of electrolytic oxygen; and this reaction tends to reduce the difference of potential, and to produce electric equilibrium.

But during the period of repose, this peroxide, being limited in quantity, and in close contact with the spongy lead, is rapidly reduced to sulphate, while the original peroxide coating on the other plate, from its greater thickness and the resistance of an excess of sulphate, is reduced much more slowly. Hence, there is a partial restoration of the original difference of potential, which accounts for the renewal of electric energy manifest in a partially discharged cell after a period of repose. These various chemical reactions result in an increased thickness of the peroxide deposit with each charge, while an increased thickness of spongy lead remains on the opposite plate after each reversal, and when the process has been continued long enough to produce a sufficient thickness of each coating for a practically serviceable cell, the alternate charging and discharging with reversal is discontinued, and the cell, being ready for use, is always thereafter charged in the same direction.

Each discharge, as shown, produces sulphate on both plates, but the oxygen generated on the plate connected with the postive pole reduces the greater part of the sulphate on that plate to peroxide, while the remaining portion, being in immediate contact with the plate, tends to preserve it from further disintegration. When the cell is put into practical use these chemical reactions continue, the same as during the forming process, sulphate being reduced to peroxide by each charge, and peroxide to sulphate by each discharge, and the electric energy varies as this reaction, and ceases when the chemical affinities are satisfied.

The electric energy of the secondary cell then, like that of the primary, is dependent on chemical reaction, the difference being that in the primary cell chemical reaction, with the generation of electricity, takes place spontaneously on the completion of the circuit, and continues indefinitely, for months or years often in well constructed cells; while in the secondary cell the electric energy must first be supplied from an external source, and the action, both chemical and electrical, is limited and definite, dependent on the amount of electric charge given.

It does not appear that Planté himself fully understood the nature of the chemicial reactions which take place, but proceeded on his practical observation of results; and it was not until 1882 that the chemical reactions producing these results were discovered by the English electricians, Gladstone, and Tribe, and described substantially as here given.

A cell prepared in this way has a maximum e. m. f. of about 2.54 volts, and a variable resistance of half an ohm or less. When fully charged, it gives for several hours a current of varying constancy, dependent on the external resistance to be overcome, after which the current rapidly declines.

With a battery of these cells Planté used a commutator by which they could instantly be joined either in multiple arc or in series. Fig. 5 represents such a battery, composed of 20 cells.

The commutator is placed above, and is constructed with a cylinder of ebonite, which can be revolved by the milled head, *B*. To this cylinder are attached, on opposite sides, two brass strips equal to it in length, against which press 40 brass springs, 20 to each strip, attached to opposite sides of an ebonite support, placed underneath the cylinder, as shown. These springs are connected by conductors with the battery electrodes below; all the electrodes intended to be of one kind being connected with the springs on one side, while those intended to be of the opposite kind are connected with the springs on the other side; and thus the cells are joined in multiple arc.

Between each opposite pair of springs, a brass pin passes through the center of the ebonite cylinder, at right angles to the strips; the ends projecting slightly, as shown in the figure. By a quarter revolution of the cylinder the contact of the springs is changed from the strips to the pins, and each opposite pair of spings electrically connected, while insulated from all the others; and thus each positive electrode is connected through the springs and pin with the negative electrode of the adjoining cell; the connections with the springs being so arranged alternately as to produce this result, and thus join the cells in series.

For charging, Planté joined the cells in multiple arc, and thus obtained a very low resistance, so that two Bunsen cells furnished a current of sufficient strength. But for discharging, he joined them in series, and obtained a maximum current equal to that of 30 large Bunsen cells. But as the battery was not a generator but an accumulator, it could only return the electricity which it had received less a certain percentage of loss from leakage, which Planté estimated at about one-tenth, and as it was used chiefly for such laboratory experiments as the heating of

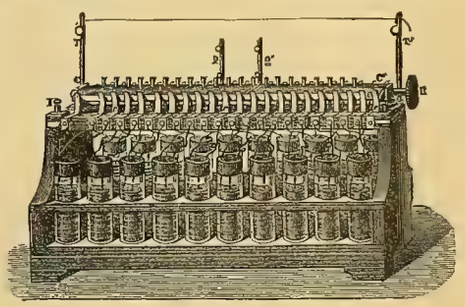


Fig. 5.

short wires, the external resistance being very low, the discharge was proportionally rapid, and hence the strength of the current quickly declined, the maximum being maintained for only a few seconds.

Such was the original battery of Planté; an invention of the highest importance when regarded in the light of subsequent development, bearing the same relation to secondly batteries that Volta's does to the primary, but of very limited practical value, and, previous to 1880, scarcely more than a laboratory instrument. But it demonstrated several very important facts: 1. The practicability of constructing a storage battery, which could give, for even a limited time, a continuous and very powerful current, far in excess of that by which the charge was given. 2. That lead was especially well adapted for the electrodes, and water, acidulated with sulphuric acid, for the electrolyte. 3. That peroxide of lead was the best material for the positive plate, and spongy lead for the negative. The principal defect was the tedious and expensive process of preparing the plates, a defect fatal to the practical use of the battery.

(*To be continued.*)

Western Electric Benevolent Association.

The annual picnic of the Western Electric Benevolent association, of Chicago, took place last Saturday. The Western Electric company's factory was closed for the day. The pleasure-seekers, to the number of about 900, took a train to Island Park at Momence. The day was a most enjoyable one. Games of all kinds were indulged in. The receipts will add a handsome sum to the benevolent fund.

Magnesium in Primary Batteries.

M. Hein has been investigating the value of magnesium as a positive element in primary batteries, says *Science*. The electromotive forces are high as compared with results ordinarily obtained; but there are the objections that magnesium is expensive (it is worth from a dollar and a half to two dollars a pound), and the resistance of the solutions of magnesium salts is greater than that of the ordinary solutions used.

POSITIVE ELEMENT.	SOLUTION.	NEGATIVE ELEMENT.	SOLUTION.	ELECTRO MOTIVE FORCE.
Magnesium	Dilute sulphuric acid	Zinc	Dilute sulphuric acid	.876
"	" " "	Copper	Sulphate of copper	2.03
"	Sulphate of magnesium	"	" " "	1.93
Magnesium	Dilute sulphuric acid	Carbon	Dilute nitric acid	2.888
"	Sulphate of magnesium	"	" " "	2.863
"	Chloride of magnesium	"	" " "	2.910
Magnesium	Bichromate solution	Carbon	Bichromate solution.	2.952
"	Dilute sulphuric acid	"	" "	2.980
"	Sulphate of magnesium	"	" "	2,901
"	Chloride of magnesium	"	" "	2.970
Magnesium	Chloride of ammonia	Carbon and manganese dioxide.		2.219
"	Chloride of magnesium	"		2.334

Chicago Underground Railway.

The Chicago Underground Railway company was incorporated last week to solve the problem of rapid transit in Chicago. That the western metropolis needs better facilities for local transportation goes without saying. The continual breaking of the cable has proved that this method of transit is inadequate to accommodate the vast throngs who daily hurry to the center of the city. It is the general purpose of the company to build an underground system of railroads similar to the Metropolitan railway of London, which will connect the center of the city with the north and west sides and the suburbs. It is claimed that the expense while great would not be as great as that of an elevated road. The first great outlay of an "L" road is for the right of way, and in the underground system this expense would not be necessary. The wear and tear, too, would be less, it is said.

It is the intention to cut down to 100 or 150 feet till bed-rock is struck and to tunnel in the several directions. At the depth of 100 feet it is expected that soft limestone will be struck, which will make the best possible road-bed and offer the least difficulty in the way of tunneling. But what if a bed of quicksand should be struck such as was recently met in the lake shore tunnel? In that event it is proposed to force through the quicksand pocket riveted tubing.

While the system is modeled in the main after the London road, it is proposed to add several improvements. The great objections to the London underground railway are its darkness and smoke. Both these disadvantages can be overcome by the employment of electric motors, and by lighting the tunnel by electricity. The climbing to and from the cars which wearies the Londoner will be avoided by elevators built at every station on the line. It is unnecessary to add that the American method of running the road would make it vastly superior to the London system. The employment of electricity would render the road pleasanter to ride on in every respect.

Necessarily an enormous capital would be required to construct such a system. The capital stock of the company is $27,000,000. It is estimated that the cost of the line would be a million dollars per mile. The promoters of the enterprise feel confident that when the plan is thoroughly understood the capital will be forthcoming. Those interested in the project are George W. Waite, Hyde Park; Wesley R. Crumpton, Frank McMaster, L. H. Clark and T. M. Nelson, of Chicago.

A man is said to have visited a London residence, and, representing that he was from the Grosvenor gallery, requested to be allowed to look at the electric light apparatus with which the establishment is provided. His request was granted. He is said to have managed to remain in the house until an opportune moment presented itself, when he forced open a number of drawers, and escaped with jewelry and valuables worth at least £2,000.

Magnetism in Watches.

By C. K. Giles.

PART II.

The foregoing are facts in physical science which must be considered in horology. Again, these illustrations and explanations will make plain the reasons why the non-magnetic or soft metal watch may possibly run well for a few months, and then change its rating radically, and refuse to take its even rating again. In these non-magnetic metals, the necessary compactness for elasticity must be obtained by physical force, compression, rolling, or by hammering; in actual use, this same force is operating to undo the work it has done before and it will accomplish it sooner or later. On the other hand, steel is the only metal which can be fire-tempered, or reduced to a condition of extreme compactness and elasticity, without the aid of physical force; it has the property of elasticity to a greater extent than any other known metal—its molecules seem to have the power of sliding one by the other, and returning to, or retaining, their original position—a sort of inter-crystalline elasticity, not possessed by any of the non-magnetic metals—a sort of "magnetic life," as it were; its *magnetic* and *elastic capabilities seem to go together;* if you reduced this steel to such a state of softness as to destroy its elasticity, it would correspondingly reduce its magnetic power; steel is, pre-eminently, a metal possessing "magnetic life." The non-magnetic watch is nothing new. The old English lever, with gold balance and brass escapement, was non-magnetic. The first crude watches made were non-magnetic: the "Waterbury" is probably a completely non-magnetic watch. Jules Jurgensen tried the non-magnetic spring in a test time-piece, and it was thrown to the foot of the list in competition, its error was so great. The tests were also made by Dent, Frodsham, Harrison, and other experts, with very unsatisfactory results—and one and all returned to the steel expansion balance, and compensation, as the only thing permanently reliable. The expression non-magnetic does not convey the meaning of any improved time-keeping qualities when applied to a watch, but rather to the contrary. Patek, Philipe &Co., the celebrated watchmakers of Geneva, have produced a non-magnetic watch, but say frankly, that it is at the expense of other and more important qualities. Mr. Gribi says "he has seen no tests which have shown non-magnetic watches not to be permanently adjustable, or reliable." We cannot do better than to quote from a circular just issued by the Geneva Non-Magnetic company, for which he is agent, and for whose utterances he should have some regard, viz: "Numerous experiments with alloys of platina have developed the fact, that while balances made from platina alloys are sometimes very promising during the first few months of performance, they invariably undergo a change after being some time in use, which destroys the accurate compensating quality of the balance. Numerous experiments with hairsprings have also developed the fact that various metals may be used to make non-magnetic hairsprings, which, like platina balances, seem very promising during the first superficial tests, but under long and regular work in the watch, these hairsprings lose their elasticity. The first palladium hair springs made possessed this fault to such an extent as to earn the reputation among English watchmakers of losing their elasticity under actual work." And, further along, Mr. Gribi shows that he does not comprehend, or misunderstands—he says, "We have not demonstrated that watches are magnetized, except," etc. Now I did make the assertion, and demonstrated it, that every watch is magnetized; the steel parts of every watch are in a magnetic condition; every molecule, or crystal, of iron, or steel is naturally magnetic, and the process of polishing and finishing steel for the delicate parts of the watch increases the intensity of this magnetic condition. Every piece of steel in the watch is surrounded by a halo of this magnetic force, as explained in the previous article. To make this visible, we give an outline of a watch case with the shield, and the reinforcing case springs outside the shield, Fig. 14, and showing the permanent magnetic condition, or lines of force, established and surrounding this watch movement encased in this shield of highly magnetic metal, and also showing the constant conditions thus provided for the escapement and and vibration. Now it is evident that the balance wheel E, with its own halo of force, in its vibrations must pass through the conditions caused by the mainspring A, and the steel pinions B, C, D; these conditions form the medium by means of which we control its movement—or, we make these conditions the governor of the rating of the watch, having already made the permanent conditions surrounding the whole. These lines of force are as tangible in strength as some material substance, a thread or a fiber, but are much more perfect, softer, and more delicate in their action, therefore infinitely more desirable as a means of controlling the balance than a weight would be. To illustrate how tangibly these lines of force operate together, or seem to join together, see Fig. 15, representing the lines of force from any two pieces of iron—the sections of a watch pinion, if you please—and showing precisely how these united lines meet at their equator, A, B. To make this connecting force visible, take a balance wheel, or a steel pen, if more convenient, slightly magnetized, so that it will operate more quickly; the same results are obtained with the balance wheel in its normal condition, but it would take a longer space of time; float it on a glass of water filled, say within an inch of the top. The balance will be seen to go to the center of the glass, with its arms arranged north and south. Take a nail, spike, or any soft piece of iron in its normal condition, not artificially magnetized, and lay it over the balance wheel, and it will be seen to move from under the iron until it reaches a position which may be called the equator of these lines of force existing between the two pieces; when the piece of iron is removed, the balance on the

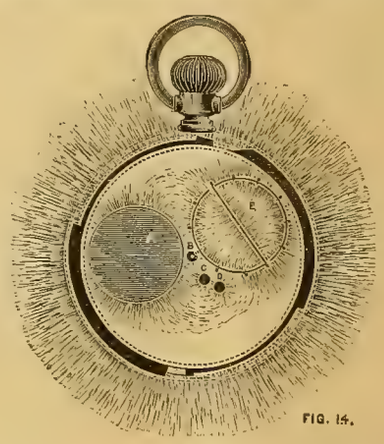


FIG. 14.

water will return to the center of the glass again. Then again, if this piece of iron is held perpendicularly over the balance floating on the water, it will move out more rapidly, and take a position further away, showing that the conditions or force are stronger at the end when the piece is held perpendicularly, and the equilibrium of force is further extended. Now, right here are made visible a few important facts in the phenomena of these lines of force, or perhaps more properly existing conditions; it will be noticed that the balance moves out from under the iron in a straight line, and to the northward, and moves steadily until it reaches the equatorial

point of the forces; there is no going beyond, and there is no recoil. It moves as if attached to a line, and stops as steadily and quickly when it reaches the length of the line; then if the piece of iron is moved gently, the balance wheel moves with it—the motions of the one are as exactly responsive to the other as they could be if materially joined together—demonstrating that they are connected by these lines of force, which seem to unite at their equilibrium point; and this is the tangible force by means of which we are enabled to control the rate of the watch; and to deprive the metals composing the vital parts of the watch, of this magnetic life, is emasculation. These magnetic lines of life are soft, gentle, even and perfect; each one of these millions of mole-

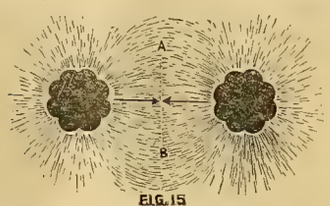


FIG. 15

cules and lines of force in the balance is doing its duty; there is no lost motion in its gearing; there is no slipping or binding, or loose jewels, etc. In using non magnetic metals in the balance wheel, the use of weights must be depended upon entirely, as the steadying power, and this at best, is harsh and uncertain; and when it comes to adjustment to temperature, the permanent from and conditions are still more uncertain, for reasons shown in illustrations.

Again it is apparent that Mr. Gribi misunderstands the nature of the shield protection. If he would read the article carefully and fairly he would see that we say the shield is magnetic. It is made of highly magnetic metal, and is a closed magnetic circuit; therefore it must be polarized, and, as is demonstrated, the general condition of all matter is one of polarity, which is a dual force, and it exists universally. We can not imagine a spot in the universe which has not this dual force of inter-etheric polarity; therefore it must exist within this circle of highly magnetic metal, and the compass needle will show the direction of this polarity. It is the object of the magnetic needle to show the polarity of any locality; otherwise it would be a valueless article. As this medium of highly magnetic metal which makes the polarity is in a complete circle, the influence is exerted equally from every point in the circumference of the circle, and the potentiality of this force which gives direction to the needle is the same, regardless of which way it points. Thus it will be seen that the watch movement

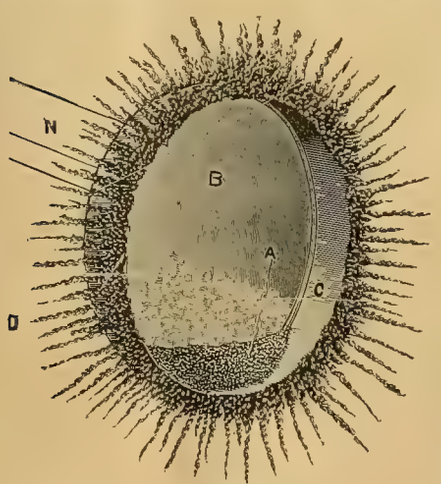
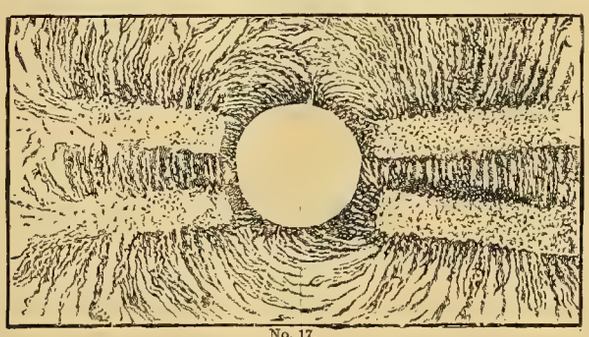


Fig. 16.

vibrating in this field of force is cutting equal lines, regardless of the polarity of the segments of the circle. As the balance has its two poles, both north and south, and as the attractive and repulsive force of the one must be equal to that of the other, it becomes apparent that it is immaterial which polarity either side of the shield circle possesses.

Then, again, Mr. Gribi shows his misunderstanding of the nature and action of the shield as well as magnetism. He says he observes lines of force in iron filings on a cardboard above the shield when the shield is placed *on* or between two magnets. This is correct, and as it should be. Mr. Gribi knows, or should know, if he is as well acquainted with magnetism, as he says, that when any highly magnetic metal is placed directly in contact with a magnet it becomes a part of the magnet, or is but an extension of the magnet; and he should bear this in mind in his experiments and not be at work on false premises. His experiments have been made with an extension of the magnet in the shape of a piece of highly magnetic metal, and he has observed lines of force which he but little understood, not knowing how they were formed, their source, or their extent. Now, it is the best possible proof of the efficacy of the shield that it is able to stand this and show its principle of action when placed in contact with the magnet, where its power is depending on its shape entirely. To test the shield properly, or to get at the principles of its operation, it may be placed in any charged atmosphere,—say between two magnets,—placed so there will be no metallic magnetic contact,—say the poles of the magnet one-half inch or more from the shield; then the cardboard and iron filings will show the same action which would occur when a watch is worn within the influence of a dynamo or in any other charged atmosphere (Fg. 17), but the metallic and magnetic contact of the watch with a magnet or dynamo, as explained above, is out of reason, and contrary to the principle of the shield, and would not occur in actual use except where it was purposely done. The finest rated watches may be easily ruined or have the adjustment totally destroyed by the lightest touch if purposely applied. The abuse of the shield may be illustrated by the diamond incident, related of an English nobleman of the sixteenth century, who


No. 17.

proposed to test the then generally conceded theory that the diamond was so hard that it was indestructible. He obtained a perfect diamond, ordered an anvil and sledge hammer, and, placing the diamond on the anvil, ordered his man to swing the hammer and bring it down with full force on the diamond. The diamond was crushed to powder; but the fact remains that the diamond is a pretty hard stone, which requires considerable purposely-applied force to crush. Perhaps it might be better explained by a comparison which is an exactly parallel case: Mr. Gribi claims his watch to be adjusted to heat and cold. Let us test it. We will put it in a dry Turkish bath, with an atmosphere up to 200 or 300 degrees, and the watch becomes worthless; will not stand the test; therefore his claim for adjustment to heat and cold is a false claim and his guarantee not good, as the watch is valueless for accurate time.

Again, Mr. Gribi says the watch will stop on the dynamo. We told him so before he tried it, and explained the reason why. We will give him another exact illustration, or parallel case. It is not elegant, but is to the point: He will admit that in a large room with the mercury standing at 20 degrees below zero, a red-hot stove would be a very desirable article to keep the atmosphere at a comfortable, even temperature; but if he was obliged to sit down on that stove, *that* would be a *metallic*, *magnetic contact*, and his ideas of the utility and practical necessity of the stove would undergo a radical change, and he would probably claim that its use was for hypothetical conditions, as it was intended to control the caloric conditions in the room, and as at 20 degrees below zero there were no perceptible caloric conditions, therefore no need of any controlling principle.

Then he asks whether a watch will run better with the shield? The answer is most emphatically, yes, and we have the actual proof of long service; and in this practical service we have arrived at an important fact in connection with the shield protection, which is, that we are enabled to obtain as close a rate from watches in actual service as we can when hanging in the jeweler's shop—it enables the watch to perform to the best of its mechanical ability. A given number of watches may run nicely on the adjuster's table, and the watch in the shield might not show so very much difference, because the conditions surrounding the adjuster's table (being practically the same from hour to hour, and from day to day), the protective properties of the shield do not have an opportunity to come into play; but when the watches go out into actual service, as is often noticed with new watches, the watch which has run the best will not hold its rate; but with the shield protected watch, owing to the advantages of the even, constant conditions which are held around the watch, as shown in Fig. 14, they are enabled to produce as good time, or perhaps better, in actual service than they have shown on the adjuster's table. As a proof of this I quote the report, as officially given, of a large number of watches carried by railway employes, which give an average result astonishingly close. Of course, it is not claimed that the watch does not vary slightly between times of comparison; it may be 1 or 2 seconds fast, or 1 or 2 seconds slow—but keeps as near the line of perfection as the watch on the adjuster's table, showing that the conditions protecting it must be constant from hour to hour, and from day to day. We get the best possible time from watches carried by dynamo engineers, because the conditions surrounding them are the most constant. In the official report of watches on the Pan-Handle road, the rating for the shielded watches for the Northern division, was:

1st quarter, average variation 1 sec. per day.
2nd " " " ¾ " " "
3rd " " " 4-10 " " "

On the Wabash railway, about 400 watches show a variation:

1st quarter, average 1¼ sec. per day.
2nd " " 1 " " "
3rd " " 8-10 " " "

On the Chicago & Northwestern railway, about 1,500 watches show an average variation of about 1 second per day for the second quarter. This shows the protection of the shield in actual every-day usage, and such astonishingly close running could not be obtained without this protection.

I can assure Mr. Gribi, notwithstanding his attempt to brush away the facts, they still exist. He may recollect that telegraphy was poohpoohed, the telephone was only a "freak of a schemer," the steam engine had but few friends in its infancy, Galileo was imprisoned for advancing ideas before his fellows were ready for them, for "treading paths not trod before," but now familiar paths of truth; therefore we are willing to concede the *honesty* of the equivalent assertions of our "Rev. Jasper" Gribi, that "the sun do move." If he thinks I am only "begging the question" as he says, he makes a grave error, and will find himself "butting the solid walls of truth," kicking against the live "magnetic pricks" of facts. I made no theorizing statements, but gave facts in the article referred to, and will stand by them, whether printed in italics, or bold-faced caps. They are capable of tangible demonstration.

(*Concluded.*)

Western Electrician.

EVERY SATURDAY.

No. 6 Lakeside Building, CHICAGO.

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PHILIP ATKINSON, Ph. D. } Associate Editors.
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EASTERN OFFICE, 30 TEMPLE COURT, NEW YORK.
W. H. TEMPLE, Manager.

SUBSCRIPTION in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of 4 or more, $2.50, with free extra copy for 8 subscriptions; foreign Countries, $4.00 a year; single copies 10 cents. **Trade supplied by Western News Company.**

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Notice to Subscribers.

Each copy of this issue of the WESTERN ELECTRICIAN contains an Index to Vol. II, covering the 26 numbers published in the half year from January 7 to June 30, 1888.

The Index is designed for convenient and ready reference to the contents of Vol. II, and should be bound with that volume.

THE Chicago *Tribune* urges Mr. Edison to hasten on the work of perfecting the phonograph, so that it can be used satisfactorily in reporting the deliberations of large bodies like the national conventions.

A LINEMAN was arrested in Staten Island City last week on the charge of burglary. He had climbed a pole, not for an evil purpose, but to repair a wire, and he was honorably discharged. How different the story which comes from London! There a sneak thief, personating an electric light employe, succeeded in entering a residence and decamping with $10,000 of jewelry.

SURROUNDED by electric lights on every side, the newspaper correspondents at the republican convention made use of innumerable electrical similes. Here is one illustration: "McKinley is manly in face, figure, action and manner. He has the magnetic attraction of a dynamometer, and there is almost as much electricity about him."

FOR an organization but a trifle over two years of age, the Order of Railroad Telegraphers, which met in annual convention in Indianapolis, Ind., this week, is remarkably vigorous. There were 75 members at the time of the first annual meeting; 2,500 at the second, and between 9,000 and 10,000 at the third, this week. With no debt, $3,000 in the treasury, and a growing membership, the prospects for steady growth are very good. It is worthy of note that a resolution favoring postal telegraphy was voted down. The next convention will be held in Cleveland, O.

THE first year of the Chicago Electric club, just closed, may be characterized as a brilliant one in its scientific and socal achievements. No wiser choice than S. A. Barton for president for the ensuing year could have been made. He is a man known in both the west and the east for his activity and energy in business, and as he proposes to be president in fact as well as name, the second year of the club's existence promises to be marked by greater achievements than the first year. At the request of President Barton, the board of managers have decided to postpone the next meeting of the club until July 16th.

A NEW argument for the electric light and against gas is found in two clippings from Maine newspapers. It is announced that great damage has been done to the trees in Mr. Blaine's yard at Augusta, by the leakage from gas pipes The Bangor *Commercial* tell this story of a tree which was set out in Fairfield, Me, last spring. "It grew fairly well last season without the electric light; but this season, under its effulgent rays, it has stretched out with great rapidity, far outstripping all its fellows set out at the same time. The explanation of this unusual growth given by the scientist on the opposite side of the street is, that the tree grows both day and night, the electric light taking the place of the sun at night. Under all the circumstances this would seem to be a very plausible explanation, and if it is true the electric light will come into general use in the hothouses and other places where it is desirable to force vegetation."

THE delegates who visited Chicago last week suffered from the heat, but their sufferings were small in comparison with the tortures which they would have endured had the immense Auditorium been lighted by gas. It is not to be expected that a hall closely packed with 10,000 persons will be in all respects a comfortable place on a sweltering day. But consider what the place would have been if 3,000 gas jets had been employed for illumination. The heat would have been unendurable, and the foul air would have caused the delegates long to remember Chicago. In the latter part of the week, when Chicago began to sustain its reputation as a summer resort, the Auditorium proved an altogether comfortable hall. The building is a credit to Chicago, and by its construction the city can claim particular distinction as a convention city. The electric lighting of the convention was successful in every respect. The illumination was perfect, and the decoration effect was unique and artistic.

THE last proposition for the solution of rapid transit in Chicago is of gigantic proportions. A company has been incorporated for the construction of an underground railroad, similar to the network which stretches in all directions under the streets of London. The novel feature of this project is the proposed employment of electric motors and of electric lights, thus removing the objections to the Metropolitan railway of London. The plan is bold enough to challenge admiration, and while many doubt its practicability until Chicago has a population of a million and more, it strikes others, whose opinions are entitled to weight, as a perfectly feasible project. That the engineering problems could be solved there is little doubt. The great question will be whether the road would obtain patronage enough to pay interest on the enormous investment which would be required. The progress of the company, if it makes headway, will be watched with interest, for the fact that Chicago needs better and more rapid means of transit, admits of no denial. The frequent breaking down of the cable system has demonstrated the inadequacy of that means of transit. Even should the cable lines work perfectly, the rate of speed will always be slow, as the cars are subject to delay at every street crossing, and at every bridge.

THE subject of magnetism in watches received considerable attention last week at the hands of Messrs. Gribi and Giles. The former discussed an article by Mr. Giles, read before the Chicago Electric club some months ago, and Mr. Giles' current article, concluded in this issue, is in reply to Mr. Gribi's arguments. The subject is an important one, and is daily taking on added importance to every man who desires to carry a watch that will indicate true time. Magnetism is as prevalent as the atmosphere itself, and no man knows when his watch will be affected unless he takes the means to secure one that is not subject to magnetic influences. A case in point: An electrical newspaper man not a hundred miles away from Chicago carried a watch for a year in and out of dynamo rooms, and, though it was not proof against magnetic influences, it escaped contamination, so to speak, during that period. The day came, however, and one morning the watch was found to be fast. In the next twenty-four hours it gained one hour and forty-five minutes, or thereabouts. As the owner did not care to gain a day over his collaborators, he took measures to provide himself a watch that was not so ambitious. This experience is but the repetition of the experiences of others, and is cited only to show how a watch not proof against magnetism will be affected.

THE great majority of editors approve the action of the New York legislature in substituting electric executions for hangings. Once in a while an opinion like that of the London *Electrician* will be found which says, "We trust it will be a very long time before electricity is called upon to do the hangman's work in this country;" but a fair sample of editorial opinion will be found in the following from the *Nation:* "The substitution of electricity for hanging in the infliction of capital punishment, in the bill which the governor has just signed, will put an end to a great deal of revolting barbarism. There never was a word to be said by anybody for execution by hanging, except that it gave a chance for the infliction of torture on the culprit through the vigor of his constitution, or the unskillfulness of the hangman, and afforded the spectators a very brutalizing show. In fact, it was its spectacular possibilities which first commended it to English jurisprudence. The criminal was hanged because he could be seen dangling by thousands when the drop fell or the cart moved away, or could be left hanging as a warning to wicked passers-by. The preservation of this mode of execution since executions have become private has been a cruel absurdity. Its horrors have been aggravated in this country, however, by our practice of making the criminal a sort of hero, and surrounding him with a savage pomp, after sentence has been passed. His cell has been open to all comers. Reporters interviewed him every day, and took down his observations on his trial, his denunciations of his prosecutors or jailers, and his maudlin reflections on his situation, and reported the flowers he received and the names of his 'callers.' All this, however, is now to come to an end. There is to be complete seclusion after sentence. The day of the execution is not to be announced beforehand, and the infliction of the sentence to be witnessed by very few, and, although the body is to be delivered to the friends, wakes and public funerals are not to be allowed."

In this connection the method which Mr. Edison advocates for the execution is interesting. He is reported as saying: "The condemned could be handcuffed in his cell, and walked out followed by the sheriff and those persons that the law says shall witness the execution. Attach each of these chains [attached to the handcuffs] to the respective poles of the battery. When the time comes touch a button, close the circuit, and," snapping his finger, "it is over. The current, which should come from an alternating machine, a machine that gives a series of rapid shocks, passes up one arm, through the heart and lungs, as well as the base of the brain and out through the other arm about a thousand times a minute. Death is intantaneous. The culprit will never know what has happened. Nothing could be surer than that way. The only disfigurement would be a white blister, which would be burned in the wrists. One thousand volts would be enough, but 2,000 volts would be sure beyond any question."

American Institute of Electrical Engineers.[1]

PROF. NICHOLS' PAPER.

MR. WHEELER: I would like to ask Prof. Nichols if he has any explanation of the sudden drop at about twenty-two degrees centigrade. I would also like to say that Prof. Thomson called my attention to the fact that he combined with a bar in series by leaving the varnish complete all the way around the bar, and then by putting lampblack on, or graphite, and plating a complete copper tube, and then connecting that at one end so that you could send the current through the length of the carbon.

MR. NICHOLS: The only trouble is that the amount of copper is so small that it is difficult to get a small enough amount. You have to have eleven ohms of copper, and that means a very small tube. This very slight change, in my opinion, is not due to incomplete compensation, but to accidental causes. It is very difficult to entirely get rid of thermo currents. It is perfectly thinkable that there might be some irregularity in the temperature coefficient which would make the compensation slightly incomplete. At intermediate temperatures I do not think it is noticeable.

DR. MOSES: By what method did you electroplate your carbon?

PROF. NICHOLS: I put it into a sulphate copper bath.

DR. MOSES: I would suggest that you could avoid the use of paint by using cyanide of copper solution. It would be adherent and very dense, and it recalls a remark Professor Thomson made this morning, that there must be some difference in the arrangement under different circumstances, because it almost resembles sulphur, and makes a very adherent coat, homogeneous, an excellent conductor, and very thin.

THE CHAIRMAN: The hour for lunch has arrived, and I think we may as well proceed to compensate our resistances according to our various standards. [Laughter.] I would like to announce that the first paper that will be read immediately after lunch, will be that by Mr. Tesla on "Alternating current motors and transformers." His paper is of a most interesting character.

AFTERNOON SESSION.

THE CHAIRMAN: At the opening of our morning session I had to announce that through serious sickness our president, Edward Weston, who was unanimously elected last night, was unable to be present. Mr. Weston has, however, made considerable effort to be with us to-day, and he comes here from a sick bed. I think, in securing the services of Mr. Weston in the presidency, the institute has secured one whose international reputation will be of benefit to it through the coming year. The institute, as you are well aware, is a society whose membership is not merely confined to New York, but extends throughout every state and territory of the union, and includes, to day, almost every country on the civilized globe. Mr. Weston's reputation as an electrical engineer is coextensive with the membership of the institute, and I am, therefore, very glad to salute him as my successor, and now introduce him to you.

PRESIDENT WESTON: *Gentlemen, and Members of the Institute:* I am not quite so sick as our former president, Mr. Martin, would lead you to believe; but since yesterday I have made a few trips between the equator and the North Pole. I have been jumping from pretty wide extremes, you see. To stop the too rapid motion I have taken considerable quinine, and it leaves me in a somewhat befogged condition of mind. I am, therefore, not feeling well enough to address the institute in the way that I should do in accepting the presidency. I feel extremely honored by the kindness of your selection. I accept the office, with grave doubts, because I doubt whether I can give as much time to it as your past worthy president has done, and show, in the same time, so remarkable a growth of the institute. I am informed that in the year of his presidency the actual membership of the institute has about doubled itself—an indication of excellent work. The papers that I have read—from what I have seen of the proceedings—have been worthy of the society. The character of the papers show a constant upward tendency. I hope it will continue so. We have nothing to be ashamed of in the past, and I hope we shall find nothing to be ashamed of in the future. I had intended to speak in full of the present state and future progress of electricity. I am unable to do that to-day. Therefore, I beg to apologize for disappointing you. I am not in a fit condition even to occupy the president's chair, and as Mr. Martin has suggested that he would rather withdraw, to-day, I would like Mr. Upton, if he would kindly do so, to accept the position, this afternoon. [Applause.]

Mr. Upton took the chair.

THE CHAIRMAN: The first paper this afternoon is on "A New System of Alternate Current Motors and Transformers," by Mr. Tesla.

MR. PHELPS: I would like about two minutes before the paper is read. I do not rise to propose a vote of thanks to our retiring president, because I think votes of thanks, like the resolutions in political conventions, pointing with pride, etc., have become a custom more honored in the breach than in the observance. But I do feel that a word ought to be said, and I am very confident that I express the general opinion in saying a word recognizing the zeal, the activity, and the intelligence which has characterized the administration of the office of president during the past year. The growth in membership, the character of the work accomplished, and, in general, all the activity of the institute during the past year constitute a record to which I think we shall always look back with satisfaction and with reasonable and just pride. It has been a matter of astonishment to me to observe the amount of time and the intelligent effort which so busy a man as our ex-president has found it possible to give to the interests of this institute. He has not spared himself in any particular; there is no work that he could do that has been left undone, and our condition at the present time is a sufficient evidence of the truth of what I say; and I haven't the slightest doubt that all here present join in what I say, and feel that it is no more than a meager statement of the facts. [Applause]

THE CHAIRMAN: Is any formal motion to be made and entered in the minutes?

MR. PHELPS; I think not, sir. As I expressly stated, I would prefer, so far as I am concerned, to avoid a formal motion; but the way in which those remarks were received sufficiently justified what I said—that they expressed the general opinion of the members present.

A MEMBER: I would move that the remarks made by Mr. Phelps be heartily accepted and approved and indorsed by the society.

The motion was seconded by Mr. Wheeler.

CAPT. MICHAELIS: I would merely like to add one word to the encomium pronounced by Mr. Phelps. I have been fortunate enough to be associated with our past president in the council during the past year, and I can heartily indorse everything Mr. Phelps has said. I would like, however, to call the attention of the institute to one fact, to which they are indebted to our past president alone, and that is the valuable addition to our "Transactions" in the shape of the bibliography that now appears with them regularly. That was Mr. Martin's idea, and it has been carried out by him. You all must know how much time such a thing has taken, and he has done that entirely of his own notion and for the good of the institute. [Applause]

THE CHAIRMAN: I understand the motion to be that the remarks of Mr. Phelps be added in full in our minutes, and with the cordial approval of the members. All those approving will signify by rising.

The resolution was unanimously carried.

MR. TESLA: I desire to express my thanks to Prof. Anthony for the help he has given me in this matter. I would also like to express my thanks to Mr. Pope and Mr. Martin for their aid. The notice was rather short, and I have not been able to treat the subject as extensively as I could have desired, my health not being in the best condition at present. I ask your kind indulgence, and I shall be very much gratified if the little I have done meets your approval.

MR. TESLA'S PAPER.

MR. MARTIN: Prof. Anthony, I believe, is here, and, as he has given this subject some attention, I think he might very properly supplement Mr. Tesla's paper with some remarks.

PROF. ANTHONY: I have been referred to as having had something to do with these forms of motor. I am very glad to be able to add my testimony to what Mr. Tesla has already given you, in regard to their action; and I confess that on first seeing the motors the action seemed to me an exceedingly remarkable one. After my first visit to Mr. Tesla's works some of the motors—I think these very two that you see here on the table—were brought to me to make some tests of their efficiency, and probably you will be more interested in those than anything else that I might say. I am sorry that I have not brought with me the exact figures that we obtained, but I can give you from memory something of the result. This little motor that you see here gave us about, half a horse power, and gave an efficiency of something above fifty per cent., which I consider a very fair efficiency for a motor of this size, as we cannot expect on such small motors to get as high an efficiency as we can on larger ones. This, I believe, is the armature that Mr. Tesla calles the armature for high rotary effort. This little pulley, which is only about three inches in diameter, gave a pull of something like fifty pounds, as I remember it, on turning on the current; so that you see the rotary effort is very considerable, and that is also shown in the quickness with which the armature will reverse its motion on reversing the relation of the two currents which pass through the two opposite coils. That could be done by shifting two of the wires, or simply shifting a reversing key in one of the circuits, and the armature would stop and reverse its motion so quickly that it was almost impossible to tell when the change took place. That shows, also, the very considerable rotary effort that the armature presents.

This motor [referring to the second specimen] gave us, I think, about one and one-quarter horse power, and showed a somewhat higher efficiency than the other—a little over sixty per cent. This would run with the armature as here constructed, almost at the speed of the generator even under a very heavy load. When the load was brought up to the maximum load, where the efficiency began to fall off somewhat, the speed of rotation was reduced. As I remember now it was reduced to about 2,800, and the speed, you see, kept up very nearly to that of the generator under heavy load.

I can add very little to what Mr. Tesla has already given you in regard to these motors. I have no question but that all of you would be as much interested as I was in seeing them work. That is really the best way in which to determine what the motors will do.

MR. TESLA: Prof. Anthony just made the remark that the speed of this motor fell off when the load was increased. That was due to the fact that this armature was designed to secure a simple effort from the start. But if we make an armature which is only designed for synchronism the speed will always be the same, no matter what the load; only there is a disadvantage that at the start the rotary effort is so small that it is apt not to start. It would generally start if put in a proper position, but if not put in a proper position it might not start. If we employ an armature consisting of a cut-away block of steel with a coil it will maintain speed at all loads. The importance of maintaining the intensity of the pole constant is that if this can be produced we can utilize, instead of the subdivided armature, an ordinary steel block with the same result. It is only desired to close the magnetic field. You can readily see, if the poles are fixed, that it is not necessary to subdivide the armature, if the intensity of the force is constantly maintained the same. But, if the intensity is not maintained the same, then it is necessary to subdivide, and generally in the results that I have obtained I have found that it is necessary to subdivide. I have also observed that in the tests of Prof. Anthony, the results obtained were superior. I attribute that to the fact that the dymamo has got a powerful field and a small armature, and the field is very concentrated; and for that reason, probably, the result is a theoretical result.

PROF. THOMSON: I have been very much interested in the description given by Mr. Tesla of his new and admirable little motor. I have, as probably you may be aware, worked in somewhat similar directions, and toward the attainment of a similar end. The trials that I have made have been by the use of a single alternating current circuit—not a double alternating circuit—a single circuit supplying a motor constructed to utilize the alternation and produce rotation. I have carried on since the last annual meeting of the institute the development and perfecting, as far as my time allowed, of a closed circuited armature, if we may so term it, related to the alternating field. The plan which I followed and which I brought to the notice of the the institute, last year, was to make a laminated field, and in that field to place an armature also laminated, winding upon the armature's coil, which periodically is closecircuited during the revolutions by a suitable commutator or circuit closing device I have made several such motors on different designs and they uniformly start from a state of rest and develop power, and some of them show, at speed close to the rate of alternations of the dynamo, a tendency to synchronize Their rotary effort, in most cases, is a little nearer that point than at other points. I hope sometime before a great while, to bring most of these results before the notice of the institute, and I would, therefore, prefer delaying further remarks on motors of this description. I certainly think there is a field for alternating motors, and there is, undoubtedly, an opportunity for obtaining motors which possess some advantages even over the continous current motors.

MR TESLA: I wish to say that the testimony of such a man as Prof. Thomson, as being foremost in his profession, flatters me very much. I might say that I have worked in the same line with Prof. Thomson at a period when the invention of Prof. Thomson was not known to me. I had a motor identically the same as that of Prof. Thomson, but I was anticipated by him. I believe that although that peculiar form of motor represents the disadvantage that a pair of brushes must be employed to short-circuit the armature coils, that such a form of motor may be made practicable for the simple reason that a motor represents a transformer, and such a transformer we well know we can bring to a very high efficiency. On the other hand, the armature may be provided with conductors that are of comparatively low resistance, and it is a mere matter of making a perfect arrangement for short-circuiting. You will see the advantage of this disposition of the closed-circuit coil—that this action is maintained always at the maximum, and it is indeed more perfect than if the polarities were shifted by means of a commutator.

1 Discussion of papers published in Nos. 21 and 22 of the WESTERN ELECTRICIAN.

Battery and Alternating Current Transformers.

The London Society of Telegraph Engineers and Electricians at the meeting April 26th, continued the discussion of the paper of R. E. Crompton, on the "Battery Transformer vs. the Alternating Current Transformer." W. B. Esson said it was generally agreed that accumulators charged with a current at 2.5 volts would give a discharge current of 2 volts, giving a maximum possible efficiency of 80 per cent. In actual practice probably even 70 per cent. would very seldom be attained, and the results obtained at Vienna, viz., an efficiency of 60 or 61 per cent., might be considered the general average. Mr. Crompton's estimate of £8,000 for the generating station, on the battery transformer system, was too small; but he agreed with the author that his estimate for the cost of the alternating machines was below the mark, as at present their cost is much higher than that of continuous current dynamos. With regard to working expenses, he did not think there would be much difference between the two systems. He thought the reliability of either system would be about the same, for though there is an objection *per se* of moving machinery, there would be very little danger of a breakdown if duplicate machinery was kept ready for use. On the alternating transformer system the alternative methods of distribution were: Large transformers feeding a net work at 100 volts; or small transformers in every house, with a primary current at 2,000 volts in a distributing network. He considered that present experience would tend to induce distrust of the permanent reliability of an underground network carrying a current at 2,000 volts. If the former system were used, the cost of the mains would be about the same as if accumulators were employed, except that the charging main in the transformer system would carry a current at 2,000 volts as opposed to one at 500 volts in the accumulator system, giving a considerable economy in favor of the transformers. He considered that, except in the matter of the charging mains, there would be very little difference in cost between the two systems.

Professor Forbes observed that the paper was of a character not often read before the society, dealing as it did, mainly with hypothetical results. He considered that the discussion was of much greater value than the paper itself. He would have liked a paper from Mr. Crompton describing the actual results obtained in Vienna and at Kensington Court, and giving precise details as to the efficiency of the accumulators. The object of the paper, as set out by the author, was to show that distribution by means of transformers had no advantages over other methods. He had then selected an example as disadvantageous as possible to the former, viz., a small 10,000-light central station supplying a closely contiguous district. Therefore, even if he made out his case in the example selected, it would not prove his assertion. He might have considered numerous other systems, and there was no doubt that the least costly would have been the system recently carried out by Mr. Stanley in America, and referred to in Mr. Mackenzie's recent paper on transformers. The speaker had formerly

obtained details of the cost of electrically lighting the club district of Pall Mall and St. James', and his calculations based on these figures, showed that the cost per candle power per annum of the different systems was as follows :–

System.	Cost per candle power per annum s. d.
Simple parallel system	2 0
Three-wire system	1 10½
Multiple series system	1 10
Multiple series system carried out in compliance with Board of Trade regulations as regards pressure at the house terminals	2 0
Simple series (Bernstein's) system	1 10¾
Transformers	1 11½
Storage batteries	2 4

The most important of Mr. Crompton's tables were those relating to the cost of installations and maintenance. He compared the table which gave the cost of a plant for an output of 600 kilo-watts, with the results obtained in America. With the Westinghouse transformer system in use there, 600 watts were obtained in the lamps per i.h.p. Mr. Crompton demanded 1,450 horse power instead of 1,000, which would be sufficient according to American practice—that is to say, he added nearly 50 per cent. to the maximum, a reserve enormously exceeding what was requisite. This would reduce all the details of his estimate. The cost of dynamos and exciters per kilo-watt given in the paper was correct according to the American estimate, but this would also include the cost of all adjuncts.

The cost of transformers Mr. Crompton estimated at £7,500, while it should have been £4,000. His chief error, however, was with resp ct to the mains, and arose from his failure to appreciate the advantages of the transformer system. His allowance of 22,000 yards of mains for 10,000 lights was too high. In a case like this no one would think of taking up the pavement and laying down culverts, because overhead wires were more suitable for a small installation of this kind. The pressure of 480 volts assumed by the author exceeded that allowed by law. His wires would carry a current of about 1,500 amperes at this pressure, and for this he assumed that a wire of 2.55 inches sectional area would be required, which could not be carried overhead. Still more would this be the case if the Board of Trade regulations were complied with. He would, therefore, reduce the estimate for the mains from £20,430 to £6,000, and the total cost of the station, on the alternating transformer system should be £34,140, instead of £57,440, and it was the former figure which should be compared with Mr. Crompton's own estimate of £59,762 for the cost on the battery transformer system. Mr. Crompton's calculations for the accumulator system also contained serious errors with regard to the efficiency. This he assumed to be 80 per cent. for the whole system—that is, for the conductors and accumulators combined—and he admitted a loss of 10 per cent. in the charging and 4 per cent. in the discharging mains. Professor Forbes found that the loss on the charging mains would be 12 per cent., making a total loss in the mains of 16 per cent., and therefore leaving only 4 per cent. for the loss in the accumulators, which would, therefore, have to give an efficiency of 96 per cent. Again, he gave 416 amperes as the rate of discharge of each cell for five hours, or 2,080 ampere hours, and stated that they were capable of a rapid discharge of 1,352 amperes. With this rate of discharge he only allowed 15 per cent. for depreciation. Professor Forbes did not know of any company that would agree to maintain storage batteries at this price. Mr. Preece, whose cells were being carefully attended to, had stated that they lost 1lb. in 16lb. during the first year. Mr. Crompton then assumed that he could get such cells as these at £40 each. This estimate of price he had only based on hearsay, as was also the case with his figures for the alternating system. If he had confined himself to his own experience; the results would probably have been very different. Mr. Crompton had stated that American experience was of no assistance ; but the speaker, on the contrary, found that during the few months in which he had recently been studying the alternating transformer system in America, he had obtained more practical information than he could have gathered by reading everything that had ever been written by English authors on the subject.

Mr. Crompton had characterized as nonsense the statement that the cost of laying down conductors was approximately proportional to the cost of the copper. This would not be the case for small sections, but for these overhead conductors should be employed. For large installations requiring heavy mains, it was necessary to put them underground, and for such installations—say of 100,000 lights—the cost of mains would be very nearly proportional to that of the copper. Mr. Crompton had offered to carry out an accumulator installation at his own estimate, it was true ; but then he would not be allowed by the Board of Trade regulations to carry it out. On the other hand, the transformer system was allowed, and the speaker knew plenty of contractors who would be very pleased to carry it out on the alternating system at Mr. Crompton's estimate of £57,000.

Professor Forbes, at the request of Mr. Preece, next gave a short account of his experience of the transformer system in America, and stated that he had been specially impressed by the small number of men attending on the stations. As an example, he stated that at Denver, where coal was the fuel used, the staff for a 7,000-light installation consisted of one manager at $150 per month, one secretary at $80, one office boy, two dynamo attendants at $70, two engine attendants, five firemen, two line inspectors, and one man for repairs. At Pittsburgh and Allegheny natural gas was used instead of coal, and the supply was regulated automatically, so that the boilers for a 10,000-light station were looked after by one man only. The Westinghouse engines were in very general use for alternate current lighting. They were not the most economical, but were very suitable ; and the Westinghouse governor, which ran in an oil bath, was extremely sensitive. The dynamos differed greatly from the types used in this country. The field magnets consisted of an iron ring, with sixteen poles turned inwards. The armature was formed of thin iron plates bolted together, and wound with sixteen coils separated by wooden laths. The construction of these machines was excellent, both mechanically and electrically, and the heating was much less than might be expected. The power used in exciting was 2 per cent. of the total output. The weight of a 2,000-light machine was 18,000 lbs., and the speed 1,000 revolutions. The space taken up by the laths ought really to be occupied by useful material. If iron were put in the cost would be very largely increased, owing to the mechanical difficulties. He had suggested that the laths should be removed and replaced by a separate circuit lagging behind a quarter of a period. This would increase the output by 25 or 30 per cent. He had tested the converters at the Westinghouse works at Pittsburgh by the same calorimetric method which Professors Ayrton and Perry had recently employed. He found that the 30-light converter, when working at half its maximum load, gave an efficiency of 95 per cent. Only three types of dynamos and five types of converters were constructed at the Westinghouse works; this restriction to a limited number of types enabled the machines to be manufactured on a large scale, and supplied at a much lower cost than would be possible if each machine were constructed in accordance with a separate specification, as was the custom in England. It also had the advantage that if any part of a machine gave way, it could be supplied immediately from the works in answer to a telegraphic order. The switch boards in use at the American central stations were remarkably small and simple in comparison with those in use in England for non-transformer systems. Some of the switches and other fittings used by the Westinghouse company were exhibited.

J. E. H. Gordon pointed out with reference to the load diagrams exhibited, that while the London diagram showed a maximum demand at 7 P. M., that for Brooklyn was at 5.30, that for Cincinnati at 5.45, and that this exactly corresponded with the difference in the dinner hour in London and the United States. Mr. Crompton had been put at a disadvantage by his desire to abstain from advertising his own wares. He himself had concluded a contract with Mr. Crompton for the supply and maintenance of Howell accumulators for the installation which he was carrying out at Whitehall. There were to be eight batteries of sixty cells each, and ten spare cells, at a cost of £6. 15s. per cell The nominal rate of discharge was to be 105 amperes with a capacity of 525 ampere hours. At a discharge rate of 200 amperes the capacity was to be 375 ampere hours. At 105 amperes discharge rate a minimum efficiency of 75 per cent. was guaranteed, 85 per cent. at 75 amperes, and 90 per cent. at 45 amperes. If these conditions were not attained, Mr. Crompton undertook to supply extra batteries at his own cost to bring the capacity and efficiency up to the required standard, by reducing the rate of discharge of each cell. The batteries were to be kept in a condition equal to new at a yearly rate of 12½ per cent. on the original cost.

Mr. Sellon thought that overhead mains would not be allowed in England as they are in the United States. Most of the advocates of the transformer system admitted that distribution by accumulators was the ideal system, and that the other was only a stop gap. Accumulators had been discredited because they could go wrong without its being immediately evident, as in the case of dynamos. This objection would not apply to the system of distribution from local stations, where the accumulators would be under competent care. He considered that the ideal method would be the combination of continuous current transformers and accumulators. During the period of maximum demand the supply would be obtained from both sources ; during the period of medium demand, or about half the time, the whole plant would be at work, and the surplus current would be used to charge the accumulators ; during the period of minimum demand the supply would be from the accumulators alone.

B. Drake thought the public preferred the accumulator system, even if they had to pay more for the light. He advocated the same mode of working as the author, viz., running the dynamo continuously through the battery, and using the latter as a source of additional supply during the period of maximum demand, and also to guard against a breakdown of the machinery. The lighting during the day to be from the batteries only.

F. King thought Mr. Crompton might have used a higher pressure for charging. At Colchester they had used 1,250 volts for two and a half years without a breakdown, and when the cables were taken up they were as perfect as when laid down, the good condition being due to their having been cased in lead. The speaker proposed to use a current of 2,750 volts for charging. Mr. Crompton proposed only four subsidiary stations, and therefore the pressure would vary considerably ; to avoid this, ten subsidiary stations would be necessary. He advocated the use of a complete storage system, as he did not think reliance could be placed on the continuous running of any dynamo, and he thought that accumulators could be constructed which could not be run down by any internal action. If the peroxide plate only lasted for three years, the accumulators could be maintained at a rate of 10 per cent. Storage batteries should never be charged in parallel, as very small differences in the counter electromotive force would produce large differences in the charging. He had made batteries which gave an output at the rate of 150 watts for seven hours, with a fall of only 4 per cent. in the pressure.

Stewart Russell thought that most of the failures in underground electric lighting cables, especially a few years back, arose from the use of inferior cables with light insulation, and with no mechanical protection. He gave instances of American cables laid underground for arc lighting from Thomson-Houston machines, which subjected them to a much greater strain than the alternating system. Among other instances of successful underground cables he mentioned cables at Milan carrying a continuous current at 1,500 volts or an alternating current at 2,000 volts ; and a cable at Brussels, five miles long, carrying a continuous current at 1,400 volts. At Silvertown, cables for arc lighting had now been underground for five years without requiring any repairs, and the two cables supplying fourteen or fifteen lamps had been laid side by side in the same trench.

Mr. Fleetwood observed that it would be quite impossible to put culverts such as Mr. Crompton described under most of the London streets, as the space was already so fully occupied that it was often imposible even to find room for 3 inch pipes. He considered the use of iron pipes to be the best means of protecting permanent underground cables.

Globular Lightning.

Captain Moore, of the steamer Liberian, according to the New York *Tribune* relates the following observations of globular lightning off Cape Race. "A large ball of fire appeared to rise out of the sea to a height of about fifty feet, and came right against the wind close up to the ship. It then altered its course and ran along with the ship for nearly two miles. In about two minutes it again altered its course and went away to the southwest against the wind. It lasted about five minutes, and, as I have at other times observed the same phenomena off Cape Race, it seems to indicate the approach of an easterly gale." Lieut. V. L. Cottman of the navy has charge of the branch hydrographic office in this city, continues the *Tribune*, speaking of this rare and most inexplicable form of lightning, said: "A globe of fire floats leisurely along in the air, in an erratic sort of a course, sometimes exploding with great force and at other times disappearing without exploding. On land it has been observed to go into the ground, and then reappear at a short distance; and where it entered the soil it left a rugged hole twenty feet in diameter. Although there is no doubt as to the facts regarding the phenomenon, no satisfactory explanation of the cause has ever been given. It is, of course, entirely different in character from the St. Elmo's fires as often seen on board vessels during thunder storms; these remain stationary at the yard arms and mastheads, and are analogous to the brush discharge of an electric machine."

Electric Railway in a Colliery.

A description of an electric railway in a colliery at Zankerdora near Dresden is given in *Engineering*. Power is generated above ground by a vertical engine having 10-inch cylinder with 8-inch stroke, which drives a Siemens dynamo. The current is led to the shaft, which is about 60 yards distant, by two bare copper wires; then down the shaft to a depth of 120 fathoms by well insulated conductors to the T rails, which run along the roof of the wagon way and form the contact rails. The current is taken off these rails by sliding contact pieces fixed to the locomotive, and is led to a switch which can turn the full current either through the motor, or first through reducing resistances and then to the motor. A controlling switch with a seat for the driver is placed at both ends of the locomotive, so that perfect control of the speed and of the starting and stopping of the motor is provided. The length of the line is about 700 yards, and the gauge 22¼ inches. A train consists of about fifteen tubs, each carrying 10 cwt. of coal; and the locomotive weighs rather over 30 cwt. The journey takes from three to five minutes, the speed varying from five to seven miles per hour. The plant cost a little above £800, including steam engine, dynamo, motor locomotive car, conductors, and accessories; it has been working successfully since 1882. The cost of hauling 660 tubs per day including interest and depreciation at 15 per cent. per year, is 19s 10½d.

New Current Meter.

A new current meter was on exhibition in Chicago last week and attracted not a little attention. It is manufactured by the Grove Electric Manufacturing company, of Philadelphia. It registers in time units very much in the same manner as the gas meter. A sixteen candle power lamp burning one hour, for example, will register 5 units; a thirty-two candle power lamp burning the same time, 10 units. It is independent of the main circuit. The clockwork is self-winding and the meter needs no attention whatever. The register is read from a dial as in a gas meter. It is enclosed in a glass case and its simplicity attracts the attention of electricians. The meter is to be put on the market at once.

Heavy Duty Engine.

The Porter Manufacturing company, limited, of Syracuse, N. Y., has constructed the heavy duty engine represented here on the principle that high piston and rotative speed, modern expansion, and valve, the wear of which does not increase the waste of steam, give the most economical results. The general design of this engine will commend itself for its plain, substantial simplicity. The massive frame, the bearings in length equal to the diameter of the cylinder, the hammered steel shaft having the diameter of half the bore of the cylinder or more, the solid pillow block, liberal bearing surface of the crosshead, the generous diameter of the wrist pins, the perfectly balanced valve—all these tell their own story without comment or extended explanations. Fig. 1 is a side elevation of the crank side. Fig. 2 is a side elevation of the steam chest side.

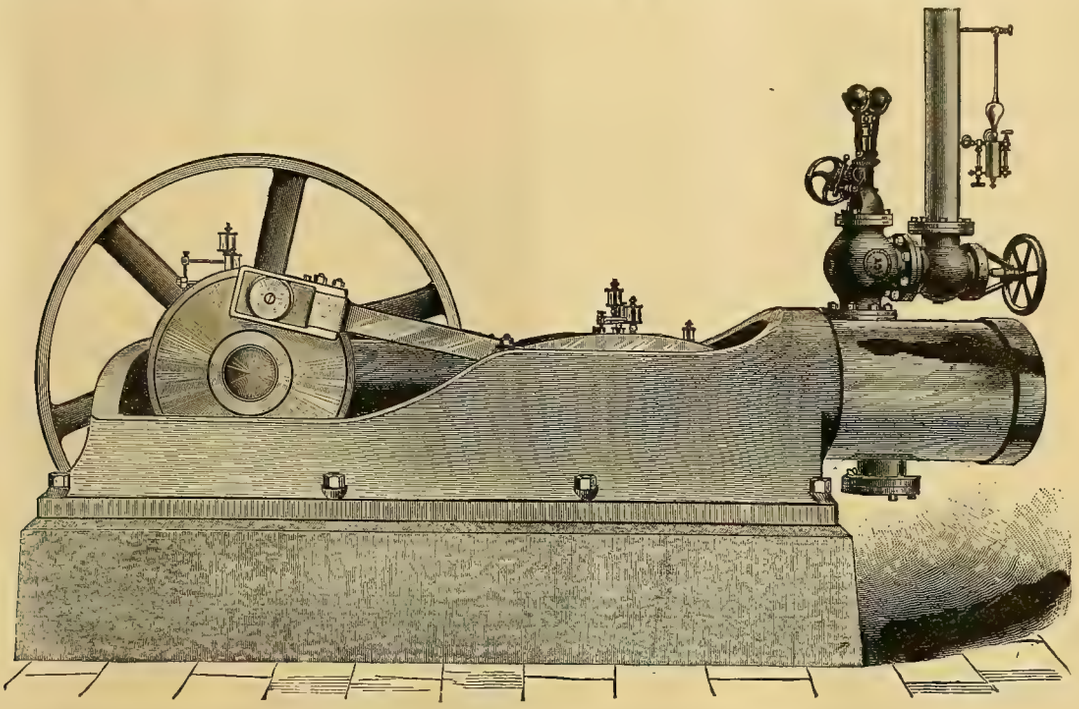

FIG. 1.

An idea of the general proportions may be obtained from the following synopsis of one of these heavy duty engines, of 243 horse power: Diameter of cylinder, 18 inches; length of cylinder, 24 inches; number of revolutions, 200; piston speed in feet, 800; diameter of fly-wheel, 84 inches; maximum width of belt, 28 inches; velocity of belt in feet, 4,400; diameter of steam pipe, 7 inches; diameter of exhaust pipe, 8 inches; floor space, width, 9½ feet; length, 16 feet; shaft bearings, 9x18 inches; weight, about 28,000 lbs.

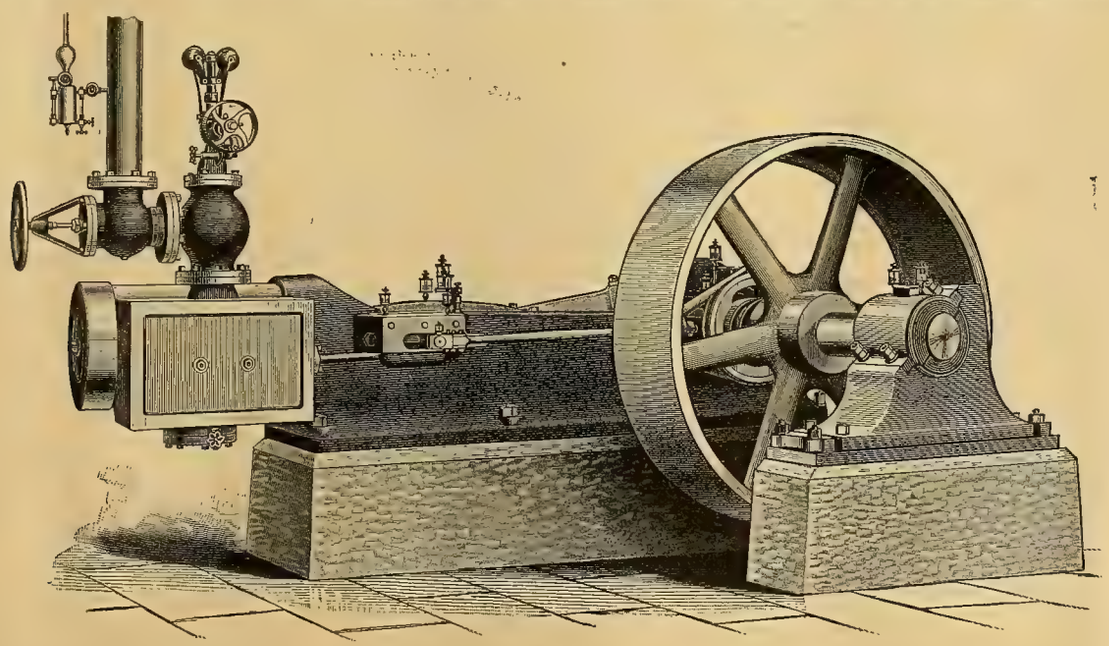

FIG. 2.

In looking at some of the details the following seem worthy of special mention: The oiling of the crank-pin is done by an ingenious device, patented by the company, whereby the oil drops from a sight feed cup; the bed is a fine, solid, rigid casting; the main bearing is lined with special babbitt metal; the cylinder is covered with asbestos and wood, which is again covered with a metal jacket; the bottom ports are placed lower than the bore, and drain the cylinder of condensation; the guides and crosshead have large, flat, wearing surfaces, with means of adjusting top and bottom guides; the crank disk is made as narrow as safety will admit, is counterbalanced and has a back plate connecting the entire crank and thereby preventing a possibility of springing; the connecting rod is of hammered iron with steel boxes and lined with special babbitt; the valve is a perfectly flat balanced valve with double steam ports, and is provided with a means of taking up wear.

Kenneth McLennan, electrician for Swift & Co., at the stock yards, Chicago, was so seriously injured Wednesday of last week, in a collision, that it will be some time before he can resume his duties. He was riding to the stock yards in a street car and as the car crossed a railroad track a freight train backed into it. The other passengers jumped for their lives, and all escaped uninjured save Mr. McLennan. He had two ribs broken and received severe internal injuries.

Gas Companies and Incandescent Light.

The paper which provoked the most general interest at the meeting of the Ohio Gaslight association at Sandusky, O., was that presented by F. W. Day, of Columbus. His subject was "The policy of gas companies as to incandescent lighting." The questions which those interested in the manufacture of gas were continually asking were, Mr. Day said: What effect will the introduction of an incandescent plant have on our business? What amount of capital does it take to put in such a plant? Can they sell light as cheap as we, and make money? Are gas companies any more favorably situated for furnishing electricity than anybody else? "The enormous sales, of incandescent electric light apparatus," said Mr. Day, "during the last year, together with the rapid improvement in the modes of generating and distributing the current, have added much that is of interest on the subject. We hear wonderful stories of a new system whereby the amount of necessary first investment in distributing plant is divided by ten, and, at the same time, the loss incident to distribution is reduced from 10 per cent., at a distance of one-half mile, to 2½ per cent., and no consideration shown to distance whatever. Verily, they sound like fairy tales. We might well ask, 'Where is it to stop?' It would seem that the limits had well nigh been reached. It is, I believe, very gener-

ally conceded that, for some purposes, the arc light is far superior to gas. It has been frequently stated that the introduction of arc lights is accompanied by an increased consumption of gas in the immediate neighborhood where the arc lights are used, which increase is directly traceable to the presence of the arc lights. Will this be the case with the introduction of the incandescent lamps? I believe not."

The common but erroneous belief Mr. Day said, that there were millions in the business of furnishing illumination had given companies interested in introducing incandescent light an almost unlimited capital. He mentioned the fact that the Edison Electric Manufacturing company had in operation at present 68 central stations with 500,000 lamps, representing a capital of about $12,000,000, the greatest part of which had been invested in the last three years. In less than eight months the Westinghouse company had established 14 plants, supplying 15,000 lamps, requiring a capital of $350,000, Mr. Day continued: "In view of these facts it is not safe to predict that the same energy and push that characterized the locating of these plants will not rest until every town in Ohio, in the business portion of which 500 lamps could be placed, has been afforded the opportunity of using them? And if they are not furnished by the gas companies therein located they most surely will be by some one else. Would a merchant be called enterprising who allowed a new article of merit, and in his line, and which he could have handled with profit, to be sold to a part of his best trade, to almost the exclusion of his own goods, simply because he refused to put it on the market—when he could have sold it at a less price, and at the same time made as large a per cent. on the the capital invested as did the other man? On the contrary, I think he would be called 'slow.'

"The skeptical will no doubt, 'What has all this to do with us?' Let us see. 1st. The introduction of an incandescent plant into the business district of a town means the loss of the gas consumption of at least one 5-ft. burner for each incandescent lamp used. 2nd. The cost of a plant would depend largely on whether the direct current 3-wire or the alternating system were used; and this, as also the cost of running it, would depend on the circumstances under which the plant was to be operated—the distance of the lamps from the station, the difference in the commercial efficiency of the generating apparatus, all coming in for due consideration. We will suppose that the system requiring the least capital was embraced—we are told that the amount of investment, including land, buildings, steam plant, and complete generating and distributing apparatus erected and ready for use, would average $25 per lamp. Adding 10 per cent. to this as a factor of safety, would make a 1,000-light cost $27,500.

"The third question requires more in reply. We will take, for example, a plant located in a town, the business portion of which would use 1,000 sixteen-candle lamps. With a 16 candle per 5-ft. gas, selling at $1.50 per 1,000 cu. ft., taking 4 hours as the average daily usage, the total consumption displaced per month would be $1{,}000 \times 5 \times 4 \times 30 = 600{,}000$ cu. ft., which at $1.50 per thousand, = $900, or an average of 90 cents per month per burner. Allowing for leakage a little less than 8 per cent., the net profit on the gas sold at that rate to pay 10 per cent. on the capital invested would be 55 cents per one thousand cu. ft., or $3.30 per month of 30 days. This would be the net reduction of the profits accruing to the gas business, resulting from the introduction of 1,000 incandescent lamps, if current was supplied from 6 P. M. until 6 A. M. Now, suppose the lamps were furnished at the cost of a 5 ft. tip, namely 90 cents per month, the income from the 1,000 would be $900 per month. No meters being used, the charging consumers with the cost of renewals of lamps, the company guaranteeing them to last 800 hours, would have a tendency to limit the hours of use to those specified in the contract; but they would still burn them more than they did the gas jets." Mr. Day estimated that the hours of use averaged 5.4 hours per day. "They would cost," Mr. Day continued, "with a consumption of 6 pounds of coal per hour per horse power, and an average efficiency of eight 16-candle power lamps per horse power, with coal at $2 per ton:

125 H. P.,	4 hours,	$= 125 \times 4 \times 6 =$	1,500 lbs (?)
50 "	2 "	$= 50 \times 2 \times 6 =$	600 "
12½ "	12 "	$= 12\frac{1}{2} \times 12 \times 11 =$	1,650 "
Coal used for banking and starting fires,			350 "
Total			4,100 lbs.

4,100 lbs. at 10 cents per cwt	$ 4 10
Water, at 30 lbs., per H. P. per hour, = 2,644 gals., at 50 cents per 1,000 gals	1 35
Proportion Superintendent's salary	2 00
Engineer and station man	3 00
Fireman	2 00
Day watchman	1 65
Lineman and helper	2 50
Repairs to engines, boilers, and dynamos, at 5 per cent. on investment	15 00
Oil	1 00
Interest, insurance, and depreciation, at 16 per cent.	12 25
Taxes	60
Making total daily expenses	$ 32 00
For average month	$32 \times 30\frac{1}{2} =$ $976 00

"The income being $900, this would make a net loss of $76 per month. If placed at 90 cents for those used until 10 o'clock, at $1 for those used until 12 o'clock, and at $2.70 for those until 6 A. M., which would be the cost of a 5-ft. gas burner burned all night, the total income would be $1,060 per month, less $976 expense, would leave a net profit of $84 per month, or $1,008 per annum; a little less than 3¾ per cent. on the capital invested. A plant under these circumstances would hardly be called a bonanza. In cases where, as Mr. Wood suggested, the waste heats could be used to such an extent as to save 50 per cent. of the fuel, and the balance could be made up of coke breeze costing 1 cent per bushel to handle, the expense of firing would be reduced at least one-half, making the whole cost of production per day:

For fuel, 2,050 lbs., at 1 cent per bushel	$ 0 52
Other expenses	27 42
Total	$ 27 94

In round numbers, $28 \times 30\frac{1}{2} =$ $854 for average month. With an income of $1,060 and an expense of $854, we have a profit of $206 × 12 = $2,472, or nearly 10 per cent. per annum on the capital as estimated by the Westinghouse people. By the operation of an arc plant in connection with the incandescent, some of the items would be divided, making net earnings considerably larger. The cost as estimated here is, no doubt, larger than it would be placed at by the electrical engineers; but we had better err on the safe side. The manufacture of a cheap fuel gas made use of in gas engines, together with the advantages of cheap and efficient storage batteries or accumulators, would lower considerably the amount of first investment, and, at the same time, cut down immensely the cost of production. However, it will not be long, now, until our energetic hosts will again be able to give us the benefit of their experience with their new venture, they being now engaged in putting in an incandescent lamp. It would seem, from the figures here given, that gas companies are much more favorably situated for furnishing both arc and incandescent lights, or electric currents, than any body else; and that they should pursue the policy of fortifying themselves in their present positions by obtaining authority so to do—if necessary. Keep an eye on the public pulse, and if they will have it, give it them. By so doing they would make a powerful ally of what might, under some circumstances, be a formidable foe. Failure to occupy a field of action in advance of others sometimes results in disaster."

The discussion of the paper was of a conservative charater. All agreed that the opinions which Mr. Day had expressed were of the utmost importance and that those interested in gas manufacture would do well to watch closely the progress of electric light. It seemed to be the prevailing opinion that at present it might not be the best plan for gas companies to invest money in electric light plants, but it was by no means improbable that in the near future such a course might be advisable and even imperative.

Seth Low has sent a long communication to the Brooklyn board of estimate, which is at present engaged in fixing the various items in the budget for 1889. He goes into an elaborate argument in favor of retrenchment in the matter of electric lighting. He says the electric light companies are now furnishing 1,007 lights of 1,200 candle power for $182.50 a year each, and he thinks, if compelled to do so by a reduction of the appropriation, they would furnish them for $75 each.

Lamp Lighting Schedule.

JULY.

Day of Month.	Light.	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	**8.00**	1.30	5 30
2	**8.00**	2 00	6.00
3	**8.00**	2.30	6.30
4	**8.00**	3 00	7.00
5	**8.00**	3.30	7 30
6	**8.00**	3.30	7 30
7	**8.00**	3.40	7.40
8	**8.00**	3.40	7 40
9	**8.00**	3 40	7.40
10	**8.00**	3.40	7.40
11	**8.00**	3.40	7.40
12	**9.00**	3.40	6 40
13	**9.40**	3 40	6 00
14	**10.00**	3 40	5 40
15	**10 30**	3.40	5.10
16	**11.10**	3.40	4.30
17	**11.40**	3 40	4 00
18	12 20	3 40	3.20
19	1.10	3 50	2.40
20	2 00	3 50	1.50
21	No	light.	0.00
22	No	light.	0.00
23	No	light.	0.00
24	**7.50**	**9.30**	1 40
25	**7.50**	**10.10**	2.20
26	**7.50**	**10.40**	2.50
27	**7.50**	**11.10**	3 20
28	**7.50**	**11.30**	3.40
29	**7.50**	**12.00**	4.10
30	**7.50**	12.40	4.50
31	**7.50**	1.00	5 10
Total number hours,			146.10

The foregoing schedule is practically good for the United States.
The time for commencing to light is calculated at one-half hour after sunset, or one hour before moonset; the time for extinguishment one hour after moonrise or one hour before sunrise.
The time for lighting or extinguishing is given for the day on which the night commences.
The time up to 12 o'clock midnight is shown by bold face type; after midnight by light face type.

CORRESPONDENCE.

Indianapolis Items.

INDIANAPOLIS, JUNE 23.—The city engineer has prepared specifications and is ready to advertise for bids for lighting the city. The specifications are substantially the same as the old ones. The bidder is to give the city the first option of purchasing the entire plant at any time within three years. Bids will be entertained for lighting the city with any kind of light, are not to be confined to electricity, and are to be received up to Monday, July 2d.

M.

St. Louis Notes.

ST. LOUIS, JUNE 23.—The bids are nearly all in for the plant of the Laclede Gas company. The directors met last Thursday and appointed a committee of three to decide on one of thirty different bids. The engine men are nearly as persistent as the representatives of the different electric manufacturing companies. The company intend to put in a plant which will have no superior in the country for beauty, economy and reliability.

Geo. J. Percival reports the sales of two 50 light incandescent machines this week. One to the Dr. Harter Medicine company, and one to the John Hogan Printing company.

C. A. Brown, of Chicago, has been in the city for a few days looking after the Laclede plant. W. J. Buckley came here on the same errand.

The telephones are being replaced as rapidly as possible by the telephone company. An effort is being made to organize an electric club here, but the outlook is not encouraging.

The post office annex is being repaired, and will be lighted by arc and incandescent lights run from the custom house dynamo.

B.

THE ELECTRIC LIGHT.

Greenville, Miss., will be lighted by electricity.

The Key West (Fla.) Electric Light company will install an arc plant at once.

The Schuyler Electric Light company will install a new plant at Knoxville, Tenn.

The city council of Marietta, O., has instructed the clerk to advertise for bids.

The Queen City Electric Light company has been formed at Dallas, Tex., with $100,000.

Lightning recently damaged the electric light plant at Portland, Oregon, to the extent of $1,000.

The Sheffield, Ala., Electric Light company proposes to put in additional machinery, to cost $9,000.

The Thomson-Houston company, of Chicago, has sold a plant of 140 arc lights to the Denver Electric Light company.

June 7th a fire destroyed the electric light works at Salem, Oregon, belonging to Thomas Holman.

The Electric Light & Motor company, of Chico, Cal., has been organized with $1,000,000 capital stock.

The Bristol-Goodson Electric Light & Power company of Bristol, Tenn., will extend its present plant.

The city of Joliet, Ill., is now lighted by the Waterhouse system of arc lighting. The people are pleased with the light.

The H. J. Edwards Electrical Improvement company in San Jose is rapidly putting up poles and wires for lighting and furnishing power.

The Thomson-Houston company, of Chicago, has sold a plant of 150 arc lights to the Columbus, O., Electric Light & Power company.

Some German sea fishermen are making experiments with the electric light for night fishing. So far the results are said to have been highly satisfactory.

Wellington W. Cummer, of Cadillac, Mich., has purchased of the Thomson-Houston company, of Chicago, a plant of 50 arc lights for central station lighting.

The Johnson City Electric Light company, Johnson City, Tenn., has organized, with J. J. Weiler as president; J. W. Thomas, vice-president; Frank Evans, secretary, and M. I. Gump, treasurer. It has ordered machinery for a 35 arc light plant.

The stokers in the Grosvenor gallery electric light plant in London recently struck because, as the secretary of the company said, a gratuitous meal was served to them cold instead of hot. The buildings supplied with light by the company were dark for one evening.

At Henderson, N. C., the Henderson Electric Light & Gas company has been organized, and proposes to build a plant at once. The officers of the company are: President, W. H. S. Burgwyn; vice-president, J. R. Young; secretary and treasurer, J. P. Taylor.

C. F. Dunderdale, the Chicago representative of the Waterhouse Electric & Manufacturing company has lately closed a contract for a large plant for the Joliet Steel company, of Joliet, Ill., which is now being installed. It comprises 45 arc lights for grounds and 25 series incandescent twenty-five candle power lamps for offices.

The Eau Claire Brush Electric Light company, of Eau Claire, Wis., have ordered of the Fort Wayne Jenney Electric Light company, through Walter K. Freeman, an alternating plant of 800 to 1,000 incandescent lights. The Eau Claire company are now burning about 130 arc lamps and have one of the best water powers in the state.

A reader of the New York *Sun* sends this query to that paper: "Against my knowledge and consent an electric light or telegraph company has attached posts and wires to the roof of my house. Can I make it take the posts down and pay for the damage it has done?" The following answer is given: "You can sue the company if you want to. The enjoyment of a law suit is apt, however, to be lingering and painful Find out whether it is an electric light company or a telegraph company. If it is the former you can cut down the wires and the posts whenever you choose; but look out for the wires. If it is a telegraph company, you can't touch either wires or posts. If, however, from any accident whatever the wires and the posts should get broken—if something on the roof should rub through the wires, for example, you can prevent the linemen from replacing them. It is against the law, technically, to destroy telegraph wires, but it would require a packed jury to convict."

It is not generally known and was not brought out at Coroner Levy's recent investigation, says the New York *Sun*, that every electric light pole becomes, during a heavy rain, charged with electricity enough to administer a perceptible shock to any one touching it. Ald. Fitzsimons found this out practically a few nights ago when walking along the street with Deputy Coroner Jenkins. He happened to place his hand for a moment against an electric light pole. The speed with which he drew it away startled his companion, who asked him what was the matter. "There's a sliver on that pole and I ran it in my hand," said the alderman. "I guess it was an electric shock and not a sliver that ran into you," said the deputy coroner, and upon investigation that was found to be the fact. One explanation is that the pole gets its charge by induction from the current passing near the iron frame surrounding the light. Another explanation is that the moisture penetrates the insulation of the wires at weak points, and covering the wires and poles with a more or less continuous sheet of water, conducts away a portion of the charge of the wires. If this is true, a rain heavy enough to keep a continuous stream flowing from a spot where the insulation was broken to and down a pole would carry off a dangerous charge, and might seriously injure a person receiving it.

In a report of Charles Neuer, United States Consular Agent at Gera, Germany, that gentleman says: "While the electric light is gradually taking the place of illuminating gas, the latter is evidently going to meet with an extensive use in another direction on account of its considerable evolution of heat. In comparison with the electric light it is this property which is—apart from minor brightness—considered as its principal deficiency. It is stated that the heat of a kilogram of gas amounts to 13,000 calories, while from a kilogram of pit coal on an average only 7,500 calories can be obtained. In other countries this heating power has been applied already for economical as well as industrial purposes. In Germany, however, such an application is to be found only in comparatively few cases, because its practical value, though proved and acknowledged by experts, is still doubted by a part of the public, while to another part it is either insufficiently or wholly unknown. Particularly the offensive smell and great expenditure form the principal objections, and they are, considering the quality of most of the gas stoves hitherto used, not unfounded. Lately some technologists and manufacturers have succeeded in inventing and introducing new systems, and it is attributed to their efforts that the people at large take a greater interest in the subject. The administrations of gas light companies are also striving to bring to the knowledge of the public the economical value of gas heating, thus complying with the fundamental principles for an extensive introduction. Moreover, in some of the largest cities like Berlin, Leipsic, etc., the price of gas for heating purposes has been reduced, and temporary as well as permanent exhibitions of gas stoves have been brought about to facilitate a complete knowledge of their uses and advantages."

THE ELECTRIC MOTOR.

It is reported that an electric road will be built at Sacramento, Cal.

There are said to be eighteen electrically worked roads in England.

The Sprague company has closed the contract for equipping the Hartford and Weathersfield railway.

The American Electric Motor company has been incorporated at Jersey City, N. J., with $1,000,000 capital stock.

The Manchester Railway and Improvement company of Manchester, Va., has received a franchise to operate an electric road in the city.

The Attleboro, Mass., Electric Light company has determined to build a railroad five miles long, which will be operated by Van Depoele motors.

The electric road is running in a most satisfactory way at Ansonia, Conn. Additional motors and cars have been ordered. The Van Depoele system is employed on the road.

Kearney, Neb., has about five miles of street railway and will soon extend the present system at least two miles. It is being arranged to run the cars by electric motors from water power as soon as practicable.

The Lewiston, Me., *Journal*, is now printed by means of a 10 horse power Baxter motor, current for which travels over seven miles through the streets of the city, after leaving the central station, before it reaches the *Journal* office.

Superintendent Aldrich, of the Carbondale Electric road, has made a remarkable record with one of his cars, which is now running its sixteenth consecutive day without change or filing of brushes. Says the Carbondale *Leader* of June 12th: Ordinarily the brushes on a railway motor with other systems are expected to need changing or replacing at least once a day, and many times oftener, and so this feat is something out of the usual line of occurrences, and shows what the Sprague motor with judicious and careful handling can do.

C. P. Maffitt, president of the Missouri Railroad company, of St. Louis, last week stated that the company about eighteen months ago received permission from the city council to place in operation a cable or an electric motor on the Laclede avenue line, and that a new motor power would be put in in the spring. The cars using storage batteries have not proved entirely successful, and the electric motor with a current of electricity on a wire suspended above the line in the street will probably be given a fair trial. However, the council before objected to the wires in the street, claiming that they would be disadvantageous, and another request will be made to allow the company to give that system a fair test. If the electric motor is not adopted, a cable will likely be placed in operation on that line next spring. It is also reported that the Washington avenue line of St. Louis has not yet abandoned the idea of further experiment with accumulators. They have ordered two more new cars of that system, which will be placed on the line in a few days.

The Kearney Canal & Water Supply company, of Kearney, Neb., has completed the canal which taps the Platte river sixteen miles west of the city, and is now prepared to lease permanent power direct from the canal. Victor turbine wheels have also been set 200 feet from the canal, to which the water is conducted from the forebay through a fifty-four inch iron pipe, with a direct fall of sixty feet, and, when preferred, power will be leased direct from the line shaft. Arrangements will be at once perfected for the transmission of power through electrical motors to all parts of the city Power can be furnished in this way in any desired quantity, from one-half horse power upwards, and at reasonable prices. The work of enlarging the canal will be continued until the capacity shall reach ten thousand horse power, or more if required. The dynamos of the Kearney Electric Light & Power company are now run by water power. Extensive plants for the manufacture of pressed brick, terra cotta ware, tile, etc., and for the cutting and dressing of stone for buildings and ornamental purposes, are being erected, and will receive their motive power from the same source.

THE TELEPHONE.

A St. Louis telephone subscriber writes to a paper in that city: "Telephone rates should be graded, if possible, according to the amount of service needed by the patron—something on the plan adopted by the commercial agencies. If a firm sends in but few questions to one of the latter he pays but $150 or so. If he needs a great deal of service he is charged as high as $250 Why, the telephone is invaluable to me. Doing business as I do, from Carondelet to Bremen, and from Belleville to the West End, I hardly see how I could get along without it But there are others who use them quite infrequently, and pay the $100 per year as a convenience in case of necessity. It would be but justice to them to charge them less than others who use the instruments more, if some feasible means could be had to adjust the rates."

Following is a dispatch from Albany: This city was visited by a severe storm June 22d. The lightning struck buildings and fired the extensive plaining mill of Willard & Barnard, in close proximity to the lumber district. The prompt arrival of the fire apparatus alone prevented a disastrous fire The flames were extinguished after two hours' hard work. The loss is comparatively small and is covered by insurance. A telephone in the store of Barnet Winne at Cedar Hill was torn out and cast into the street and the side of the building demolished. An excursion party from this city took refuge in the store and several were prostrated by the electric fluid. Several yachts of the Albany Yacht club, which had its regatta to-day, were capsized during the storm and the crews had narrow escapes.

THE TELEGRAPH.

The Los Angeles, Cal., grand jury recently recommended that the telephone and telegraph wires be put underground.

A London correspondent is informed that the crown agents for the colonies have decided to enter into a contract for the laying of a telegraph cable from a point on the coast of Western Australia to India or Ceylon, so as to be in connection with the Indian telegraph system. The sole right to work the cable will be conceded for 21 years.

The Nebraska Southern Railway company has lately been incorporated under the laws of Nebraska with general offices at Superior, Neb. The capital stock authorized is $6,000,000. The directors are: Aaron S. Everest, C. E. Adams, James H. Kesterson, Ashur Beal, J. M. McElhinney, A. C. White, and F. P. Bownell. The general nature of the business to be transacted is the construction, maintenance and operation of a railroad with telegraph lines in conection therewith.

The Boston *Herald* in an article on cable dispatches describes the dismay of an Irishman who handed in a cable message which was to be sent to a relative in Aspinwall, and was informed that the charges would be $166 56. The clerk who was interviewed on the subject said: "That sort of thing is happening all the time. Ignorant people get the idea that they can send anywhere for 25c. Lots of them try to wheedle us into taking less than the tariff and others try to bully us. Some want us to send collect, which we won't do, save in answer to messages, and some want us to charge it. The charges for cable service are so outrageously out of proportion to land service that inexperienced persons are staggered. Now a ten word message, with its direction and signature, costs only $1 to San Francisco, and counting the address and signature seven words, not less than $117.98 to Aspinwall, and yet the distance is about the same. The American cable companies are not responsible for these terrific rates, for they have to charge the rates prescribed by the governments or companies they connect with."

"Yes, I am the telegraph operator, says a hard-working man in the Boston *Globe*," and I claim the honor of being the hardest-worked man in the business, even though I do run a country office and am called a plug by the city men. I hold no less than twenty positions. I am town clerk, justice of the peace, real estate agent, insurance agent, postmaster, stage agent, express agent and manager of the telegraph office For the express company I act as shipping clerk and delivery clerk, and in the telegraph office I am manager, chief operator, night manager, cashier, receiving clerk, delivery clerk, operator, book-keeper, batteryman and messenger. In addition to these I am president of the village debating club, I owe my popularity to my telegraphic abilities. The inhabitants of this out-of-the way locality look upon the telegraph as a wonderful and awe-inspiring institution, and they ascribe to me an almost superhuman knowledge and power. Only last week I received a call from a victim of chronic rheumatism, who had heard of electric cures, and thought I must be so charged with the fluid that I could make him a well man by the mere laying on of hands. I am frequently asked if I do not feel the injurious effects of electricity that the instruments give off to the atmosphere."

Miscellaneous Notes.

Henry Banta, keeper of the Nyack city dog pound, has made preparations to kill every dog by electricity.

The Western Electric company of Chicago has put a complete fire alarm system in the Stewart hotel, San Bernardino, Cal.

It is stated that Dr. J. C. Walker, of Great Bend, Kan., has invented an electrical attachment that can be applied to any battery, to be used in extracting teeth or other work in dentistry. He has applied for a patent.

A dispatch from Wilkesbarre, Pa., dated June 24th, says: "During a thunder storm here to-day lightning struck the Puritan Congregational church while service was being held, and many of the audience were prostrated by the shock. Over a dozen women fainted from fright. A panic ensued, but was allayed by the pastor calling out: 'Fear not; you are in God's house.'"

In the case of a person listening to his own voice and utterances from the graphophone, there is much for curiosity, if not wonderment says the Boston *Herald*. The person who never heard himself speak as he has heard others (outside of himself, as it were), is astonished at its sound. "Can that be my voice as others hear it?" he mentally asks, for it sounds in his ear with an almost unfamiliar ring and tones.

The interior of the Tenth Presbyterian church in Philadelphia has been badly damaged in a mysterious manner. A large portion of the ceiling fell during last week, completely demolishing the costly chandeliers and a number of pews; the gallery on the east side was wrenched from its place and is in danger of falling. It will cost at least $500 to repair the damage. One theory advanced for the wreck is that during an electric storm the jarring of the thunder

may have caused the building, which is sixty years old, to settle.

The Duc de Feltre has designed an instrument, which he calls a phonozenograph, intended to indicate the direction of any distant sound, says the London *Electrician*. A microphonic plate of peculiar construction is fixed in a vertical plane, and is in circuit with a battery and a telephone receiver, or a Deprez-D'Arsonval galvanometer and a Wheatstone bridge. The microphone is more or less affected by a distant sound, according to the angle that it makes with the source. By moving the plate about until the maximum effect is obtained the observer is enabled to exactly locate the direction of the sound. The indications of the telephone receiver are absolutely accurate, but those afforded by the galvanometer are less so, and this latter arrangement will require great modification of the microphonic plate before it can be said to be of a practical nature. This instrument may possibly prove of use at sea in preventing collisions in foggy weather.

Scientific men are deeply interested in the phenomena accompanying the building of railroads in Mexico. Recently great damage has occurred to the Mexican Central from water spouts bursting on the track. It seems to be a fact that water spouts are attracted by iron tracks and telegraph wires. Engineers assert that as fast as construction advances rain follows, and they believe this to be owing to the large quantity of steel rails on flat cars, which are carried forward in the work. They add that the country before and behind is dry, but where the steel rails are accumulated the water comes, within a circuit of a few miles, in bucketfuls. We seem to be steadily approaching the solution of problems of great importance concerning the artificial production of rain and the effect of railroads on electrical discharges and distribution. It is not improbable that our arts are closely associated with climatic dangers as well.—*Globe-Democrat.*

MM. Gouy and H. Rigollot describe a form of apparatus for measuring the intensity of light. They have found that a plate of oxidized copper submerged in a solution of chlorine, bromine, or iodine becomes extremely sensitive to luminous rays, even of the feeblest intensity, and can be employed as an actinometer. In a solution of sea water two plates of copper, one of them being oxydized, have in total darkness an e. m. f. of some thousandths of a volt. When light is admitted this e. m. f. increases, the oxidized plate becoming more positive. Two similar plates will equally answer if only one is exposed to the light. Singularly, the variation of e. m. f. is more pronounced through a circuit of several hundred ohms. The experiment succeeds very well with a Deprez-D'Arsonval galvanometer; with a Thomson galvanometer the sensibility is greater still, the effect of a single candle at several yards distance being quite noticeable. The oxidized plate can be easily prepared by heating in a Bunsen flame. This apparatus is very easily made and employed, and may render many services in scientific experiments and other applications.

Since the electric railroad was installed in Ansonia, Conn, a great many stories have been reported from that enterprising place. Here is the last: From the motor the current passes through the wheels to the rails and is supposed to return to the plant again. But it does not—all of it. There is a big quantity escaping all the time, varying in intensity according to whether the cars are running light and on a level stretch of track, or whether they are heavily loaded or going up some of the steep grades, of which there are several on the line. The electricity escaping into the ground affects the telephone system and causes a disagreeable and annoying buzzing sound. Besides, it causes the drops to fall in the central office, and no way to remedy the difficulty has been found. It remained for the ever-present small boy to discover a benefit in the escaping electricity. Not far from the street where the tracks are laid runs the Naugatuck river. In this the boys are wont to bathe. On Saturday, when the youngsters met in swimming, they were astonished at the peculiar sensation they experienced. It was not at all disagreeable. On the contrary it was pleasurable, though at times some of the boys would give a jump and a yell as though they had stepped on a piece of glass and cut their feet. The feeling was so pleasant that some of them remained in the water for hours, and only came out when hunger forced them to go home for supper. It is learned by experiment that the sensations were caused by the electricity, and it is proposed by the shrewd Yankees of this money-making town to lease the banks of the river and establish bathing houses, that people may take a pleasant, invigorating bath at a small cost.

"What is your opinion upon the subject of lightning rods?" was asked of Chief Walker, of the city electrical department, by a Philadelphia *Recorder* reporter. "Candidly, in nine cases out of ten," he replied, "I think they are humbugs. I believe it is a fact that more barns are struck and burned that have lightning rods on than with them off. In the first place, it is best to keep electricity as far away from a building as possible. The object of the lightning rod is to attract it. The rod is supposed to act as a conductor of the electrical current to the earth, but instead of being carried off, the current, in consequence of faulty construction of the rod or attachments, is frequently switched into the building. The end of the wire is supposed to be buried in moist earth, the moisture acting as a good conductor. Without strict attention the iron becomes oxidized and rusts off, and then the rod is worse than nothing. It is a positive danger under such circumstances, attracting the electricity of the atmosphere, and having no adequate outlet for it. Then, again, the same danger arises when the insulators upon the sides of the building become defective. The lightning is attracted from the atmosphere, where it might have remained but for the rod, and it is turned loose against the building on its way to the earth. If, for instance, the attachments on a barn are poor or worn out the current may be deflected and set fire to the building. This is no uncommon occurrence. In this city some years ago the rod on the Belmont water-works was struck, and it fused. The current flowed on down and played about the machinery in the liveliest kind of a way. A big stone was knocked off the Washington monument by lightning. When the ground contact is good and the lightning is about to strike a building a rod may be of use, but I think the rods do more harm than good. There was a time when farmers were scared into rodding their barns and houses, but I think they are getting over that."

Personal Paragraphs.

A. A. Forman, of Eau Claire, Wis, was a guest at the Chicago Electric club last Saturday.

A. F. Stanley, of Hazazer & Stanley of New York, visited his old friends in Chicago last week.

H. A. Glasier, vice-president and western manager of the Jarvis Engineering company, is just home from the east.

William Harrison has been appointed general manager of the Helena Steam Power & Electric Light company of Helena, Montana.

E. C. Sims, agent of the Armington & Sims Engine company, Chicago, is dangerously ill at Niagara Falls. Mr Sims is a brother of Gardiner Sims and has many friends in the west who will anxiously await a favorable outcome.

Brainard Rorison, secretary and general manager of the Jenney Electric company, of Indianapolis, returned a few days' since from a six weeks' stay upon the Pacific coast. The company's business is large throughout California, and is growing rapidly.

Henry D. Hall, secretary and treasurer of the Consolidated Railway Telegraph & Telephone company since its organization, has resigned, and will spend the summer in Colorado. His resignation was received by the directors with earnest and complimentary expressions of regret.

S. A. Barton, the new president of the Chicago Electric club, and general manager of the Thomson-Houston Electric company, left for the east Monday, to be gone two weeks. The inaugural meeting of the club will be postponed until his return.

It is significant of the enterprise and inventive skill of American electricians, says *Industries*, that at the time these lines were being printed Nikola Tesla brought before the American Institute of Electrical Engineers an actual solution of the problem which we on this side of the Atantic merely foreshadowed as possible at some future time. The solution may perhaps not be perfect in its present form; but as far as it goes it is a long step in the direction of applying alternating currents for motive power purposes, and as such it will be appreciated by those of our readers who are interested in the distribution of electricity from central stations.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	350	375
Central Union	47	48
Michigan	79	80
Great Southern	35	40
Colorado	19	21
Rocky Mountain Bell	40	45
Cumberland	65	68
Wisconsin	108	109
Bell of Mo.	160	165
Iowa Union	27	28
Missouri and Kansas	70	71

Business Mention.

The Electrical Supply company, of Chicago, have the sole control of, and are placing on the market, a commutator conserver which will entirely prevent sparking in electric dynamos.

The Central Electric company, of Chicago, have made arrangements to handle the Grove current meter described on another page.

Electrical Patents.

Issued June 19, 1888.

384,638. Dynamo Electric Machine. Robert Oliver, Alpena, Mich.

"Claim 1. In a dynamo electric machine, the revolving armature disk consisting of a skeleton wheel provided with a series of rectangular recesses, a series of generating bobbins secured within said recesses, retaining plates secured to the sides of the armature core, an insulating ring secured to the rim of the skeleton wheel, and commutator strip secured to the face of the insulating ring."

384,644. Multiple Switch-Board Testing Apparatus. Charles E. Scribner, Chicago, Ill.

The invention consists in including a condenser in circuit with the telephone at the different subscribers' stations and in providing a test battery and signal instrument at the central office and switching apparatus for connecting said battery with the different telephone lines, whereby it may be determined whether the condenser of any given line is included in the circuit, and thereby enable the operator to determine whether the telephone of the given line is on or off the hook—that is, to determine whether the line is in use.

384,645. Magnetic Separator. M. Holroyd Smith, Halifax, County of York, England.

"Claim 2. In a magnetic separator, the combination of a rotating cylinder having its face made up of a series of magnets, a trough arranged along the face of a cylinder, and a series of propellers in said trough."

384,662 Magneto Electric Fuse. Edmund L. Zalinski, U. S. Army.

384,676. Automatic Electric Gas Cut-Off for Railroad Cars. Frederick C. Brower, Syracuse, N. Y.

384,685. Electric Railway. Stephen D. Field, Yonkers, N. Y.

We give claim 10: "The combination of a circuit completing device, as B, adapted to travel in a conduit and having a brush at each end thereof, said brushes being separated by the space described, and an insulating box or housing, K, for said device, having slots therein, through which the brushes protrude, whereby the device is prevented from establishing an electrical connection, except through the brushes."

384,755. Danger Signal for Bridges Milon O. Godding, Monrovia, Cal.

384,775. Electro-Magnetic Parcel Carrier. Morris C. Mengis, New York, N. Y.

384,796. Electric Gas Lighting Device and Gas Cock. William Tag and Sanford C. Smith, Philadelphia, Pa.

384,806. Rack for Electroplating. William W. White, Waterbury, Conn.

384,810. Automatic Electric Block Signal System Thos. D. Williams, Allegheny City, and John S. Lucock, Bellevue.

"Claim 3. The arrangement of two or more line circuits consisting of line wires and differentially wound polarized relays connected together in series by connecting one coil of each such polarized relay at each station with the line wire of one circuit and the other coil of the same relay with the line wire of the next adjoining circuit."

384,811. Apparatus for Operating Automatic Block Signals. Thomas D. Williams, Allegheny City, and John S. Lucock, Bellevue.

384,815. Incandescent Lamp Socket and Switch. James J. Wood, Brooklyn, N. Y.

384,816. Commutator for Dynamo Electric Machines. James J. Wood, Brooklyn, N. Y.

The object of the invention is to prevent the metallic dust which is worn off the commutator from lodging within the armature or between parts of the commutator or armature, and thus causing short circuits, and at the same time allow a free circulation of air through the hollow of the armature. We give claims 3 and 12:

"3. The combination, with an electric commutator and armature, substantially such as set forth, of an annular shield of mica closely embracing the commutator, and covering the connection between armature and commutator.

"12. In an electric commutator, substantially such as set forth, a flaring and deflecting ring arranged between the segments and the base flange or hub."

384,817. Electric Arc Lamp. James J. Wood, Brooklyn, N. Y.

Claim 7 is as follows: "In an electric arc lamp, a hand switch having an elongated rotary spindle, with a resistance coil wound over and mounted loosely upon the said spindle."

384,830. Railway Signaling. Thomas A. Edison, Llewellyn Park, N. J., and Ezra T. Gilliland, New York, N. Y.

The invention relates to signaling systems for communicating between stations and moving trains by induction from the telegraph wires to the roofs of the cars, and is designed to increase the quickness, rapidity and clearness of vibrations.

We give claim: "4. In transmitting apparatus for induction railway signaling, the combination, with the transmitting battery and key, of a diaphragm vibrator, in circuit therewith."

384,856. Electro-Magnetic Time Lock. Charles J. Kintner, New York, N. Y.

The invention consists in a time mechanism located at a police station in connection with an electrical circuit joining said police station and the safe to be protected, these connections being such that any disturbance of the circuit will immediately cause an alarm to be set up at the police station.

We give claim: "1. The combination of a safe lock and electrical connections with a time mechanism located outside of the safe for controlling the operation of such lock."

384,875. Electric Fire Alarm Apparatus. George M. Stevens, Cambridge, Mass.

384,901. Guard Rail and Insulator for Electric Railways. Horatio A. Foster, Boston, Mass.

384,908. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

384,909. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

We give the first and last claims: "1. In an electric railway, the combination, with the rail track, of an exposed working conductor and a shield or guard to protect said working conductor at portions of its length corresponding to stations or crossings, but allow access thereto by the collector on the vehicle.

"12. In an electric railway, the combination of a working conductor, a traveling vehicle, and a moisture wiper carried thereby on a transverse axis and adapted to wipe the working conductor."

384,910. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The invention consists in placing the batteries in compartments arranged upon each side of the vehicle forming a passage way longitudinally between them; and, further, in so locating the batteries that they shall come over the wheels, whereby the weight shall be in or substantially in the plane of the wheels.

384,911. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

384,912. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

384,934. Electric Stopping Mechanism for Looms. John Rush and Edwin Oldfield, Norwich, Conn,

C. F. DUNDERDALE,
Electrical Engineer,
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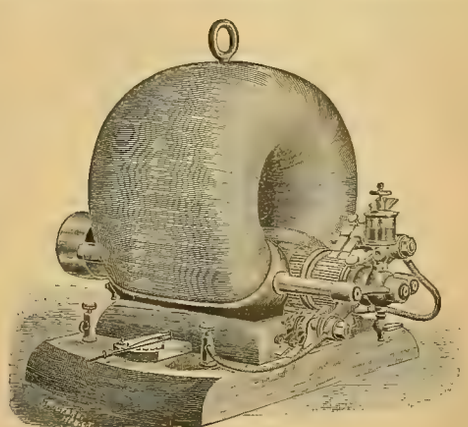

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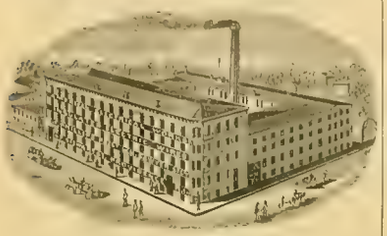

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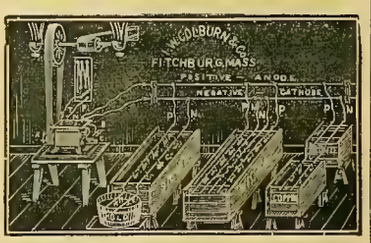

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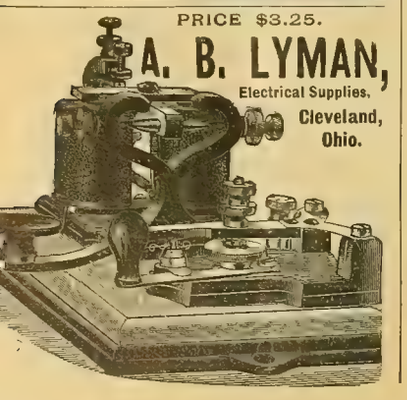

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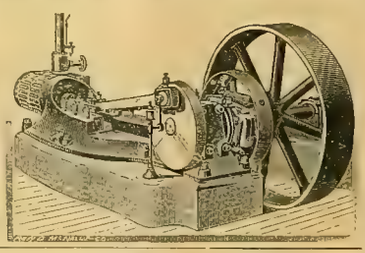

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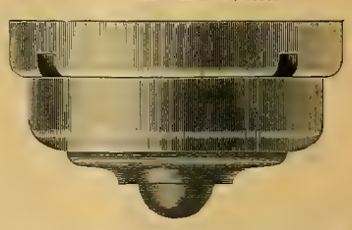

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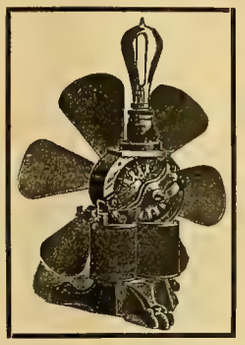

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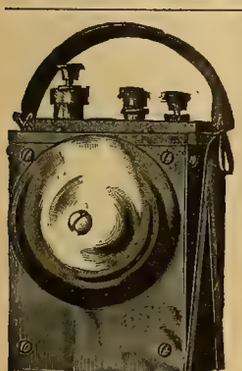

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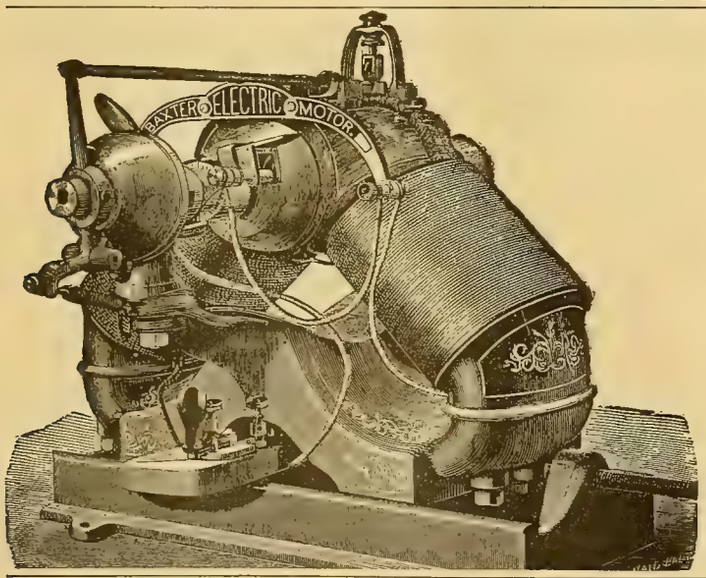

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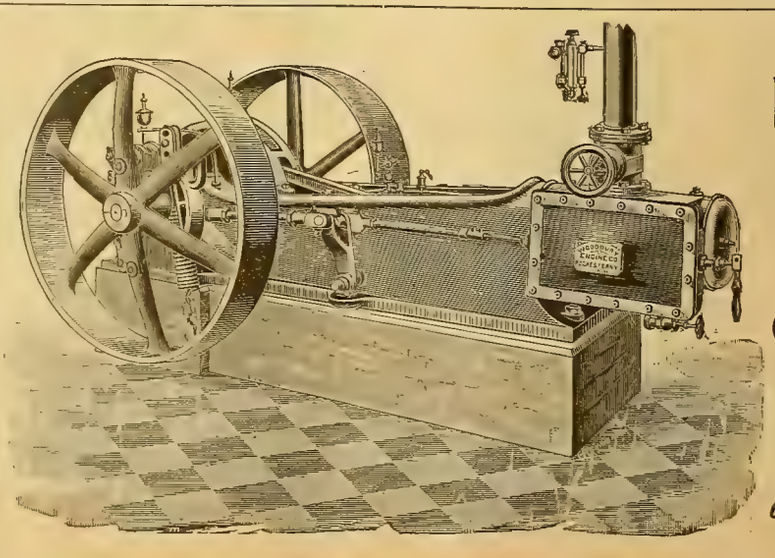

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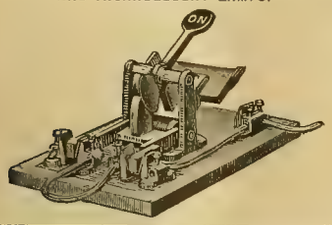

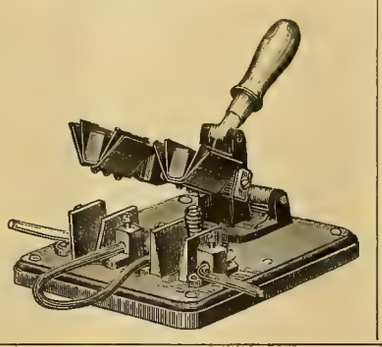

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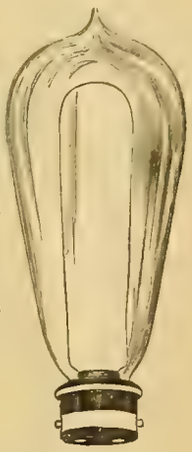

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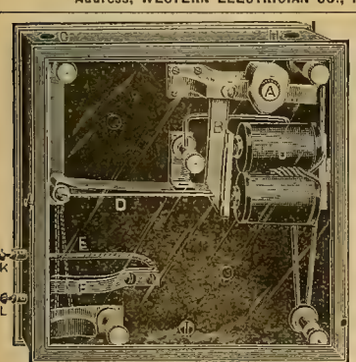

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Calipers, Micrometer.
Caliper Rules, Engineers'.
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Coppers, Soldering.

Corner Bit Braces.
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Crow Bars.
Cutters, Carew's Wire.
Cutters, Gas Pipe.
Cutting Nippers.

Diggers, Pole Hole.
Digging Bars.
Drawing Knives.
Drills, Bit Stock.
Drills, Breast.
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Drills, Long Wood Brace.
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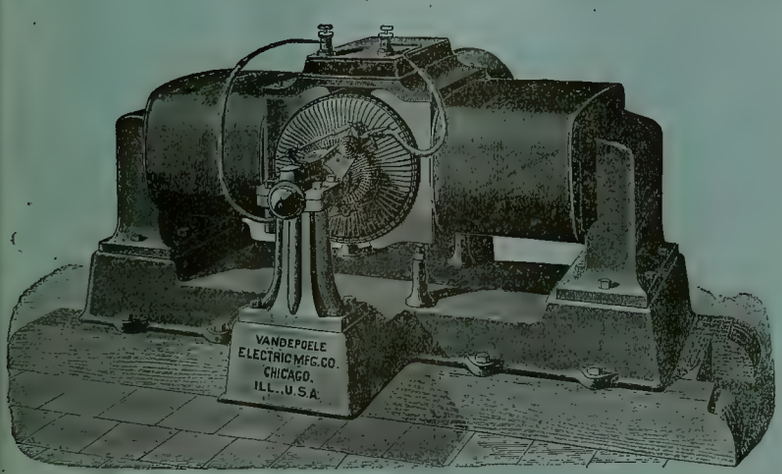

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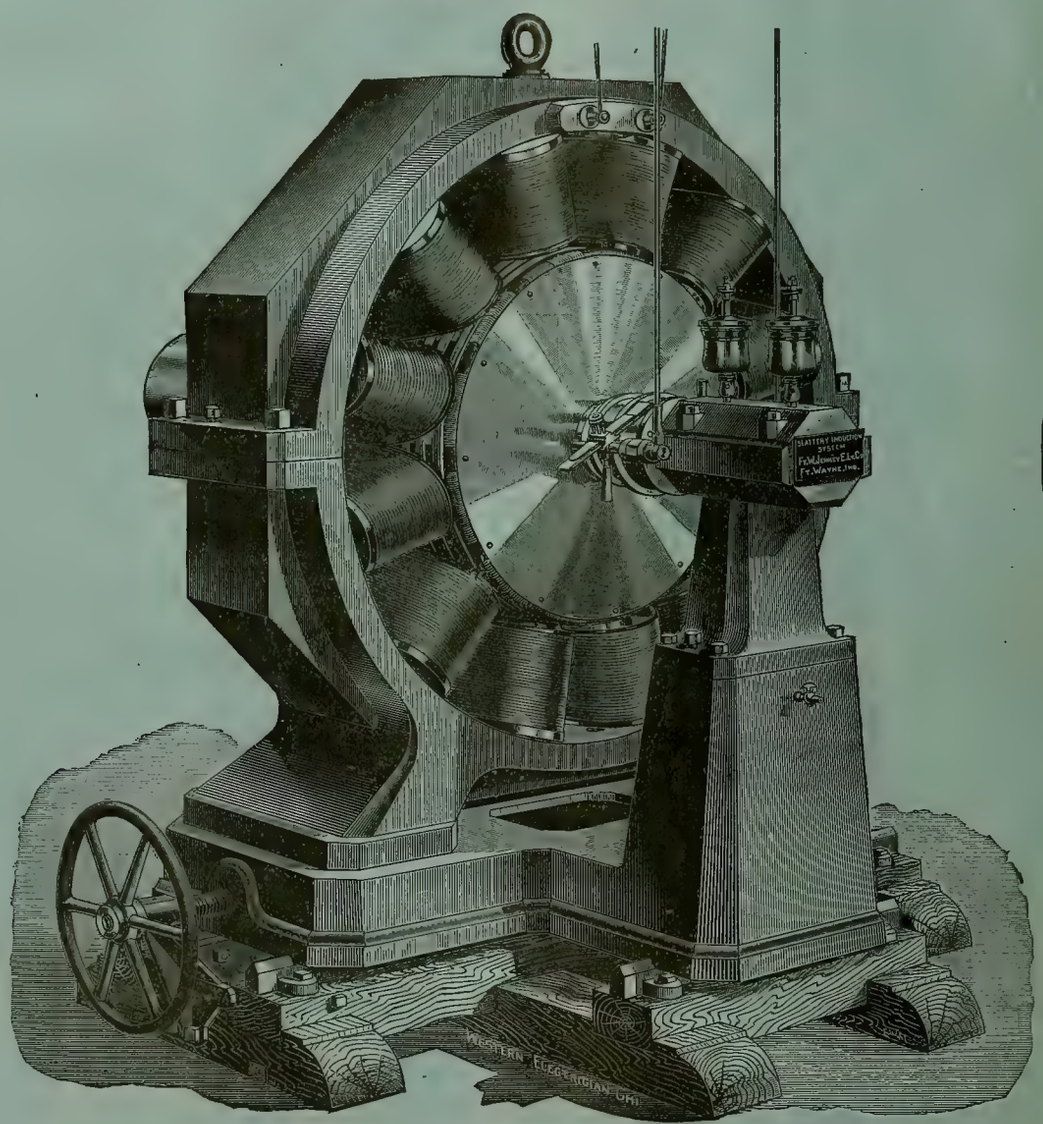

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16

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